BRITISH COLUMBIA ENERGY SUPPLY AND REQUIREMENTS FORECAST UPDATE 1987–1992

Ministry of
Energy, Mines and
Petroleum Resources
Hon. Jack Davis, Minister

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BRITISH COLUMBIA
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Preface

The forecast update was prepared in November and December, 1987. While this document provides an overview of British Columbia energy markets, more detailed information on provincial energy use is contained in the Ministry's forecast database.

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Executive Summary

Overview

* Total primary energy requirements are projected to increase 1.7 percent per year from 904 PJ in 1987 to 984 petajoules (PJ) in 1992.

* Lower energy prices will reduce but not reverse the rate of improvement in energy efficiency.

* The commercial sector and the pulp and paper industry will experience the highest rates of growth in energy consumption.

Electricity

* British Columbia's firm hydroelectric surplus is expected to disappear by 1990 with no new hydroelectric facilities required before the late 1990's. West Kootenay Power and Light's proposal to add a 140 MW gas turbine unit in 1989 has been included in the forecast.

* Electricity price increases are expected to be less than inflation as B.C. Hydro is not planning any major construction and costs to the utility are expected to decline.

* End-use electricity requirements are projected to grow 2.5 percent per year from 185 PJ in 1987 to 209 PJ in 1992.

Natural Gas

* The Province has more than sufficient deliverability of natural gas to meet domestic demand and existing export commitments. The new natural gas surplus test indicates that there are 5.3 exajoules (EJ) of marketable reserves available for new export and domestic contracts.

* The deregulation of natural gas markets has lowered gas prices to all British Columbians; prices will firm by 1992 as the North American gas bubble dissipates.

* Natural gas requirements will grow 3.4 percent per year, increasing from 184 PJ in 1987 to 226 PJ in 1992.

Oil

* Oil production will decline from 87 PJ in 1987 to 54 PJ in 1992 increasing the Province's dependence on Alberta supplies.

* World oil prices are expected to remain constant in real terms over the next five years.

* Demand for refined petroleum products is forecast to decline from 343 PJ in 1987 to 338 PJ in 1992.

1. Introduction

1.1 Background

The Ministry of Energy, Mines and Petroleum Resources has been publishing comprehensive long term forecasts of Provincial energy supply and requirements since 1980. This forecast update departs from past practice in two ways. First, the focus is on the short term outlook. Second, the published document is considerably shorter, containing only the highlights of the forecast.

A new long term forecast will be published in the autumn of 1988. It is intended that the long term forecast be issued biennially, with the short term forecast update published in the intervening years.

This report incorporates the impact of a number of changes which have occurred since the publication of the August 1986 long term forecast. World oil markets have seen prices rise from the $US 15/bbl level in 1986 to average $US 19/bbl in 1987. Deregulation in natural gas markets has led to significantly lower gas prices for all consumers. Large industrial users who have been able to arrange direct sales have benefited the most. The impact on the requirements for natural gas and other energy products arising from the proposed Vancouver Island natural gas pipeline have not been included in the forecast. A formal application to the Ministry of Energy, Mines and Petroleum Resources for a project to bring gas to the Island is expected in the Spring of 1988.

The economic and demographic forecast which underlies the energy forecast was prepared by the Ministry of Finance and Corporate Relations in July 1987. Gross domestic product (GDP) in British Columbia is forecast to increase 2.8 percent per year between 1987 and 1992. British Columbia's population is expected to grow over the next five years at an average rate of 1.2 percent per year from 2.9 million to 3.1 million.

1.2 Report Structure

This report consists of seven sections. Section 1 provides a brief introduction and background to the forecast. An overview of Provincial energy supply and requirements is contained in section 2. Section 3 outlines the Ministry's projections of oil, natural gas and electricity prices, on which the supply and requirements forecast is based. Sections 4 and 5 respectively contain a review of provincial energy use on a primary and secondary basis. The outlook for energy supply is summarized in section 6, and some key forecast sensitivities are examined in section 7. Appendix A contains conversion factors. The table in Appendix B reports primary and secondary energy requirements by fuel and sector.

Figure 2.1 : Energy Supply and Requirements

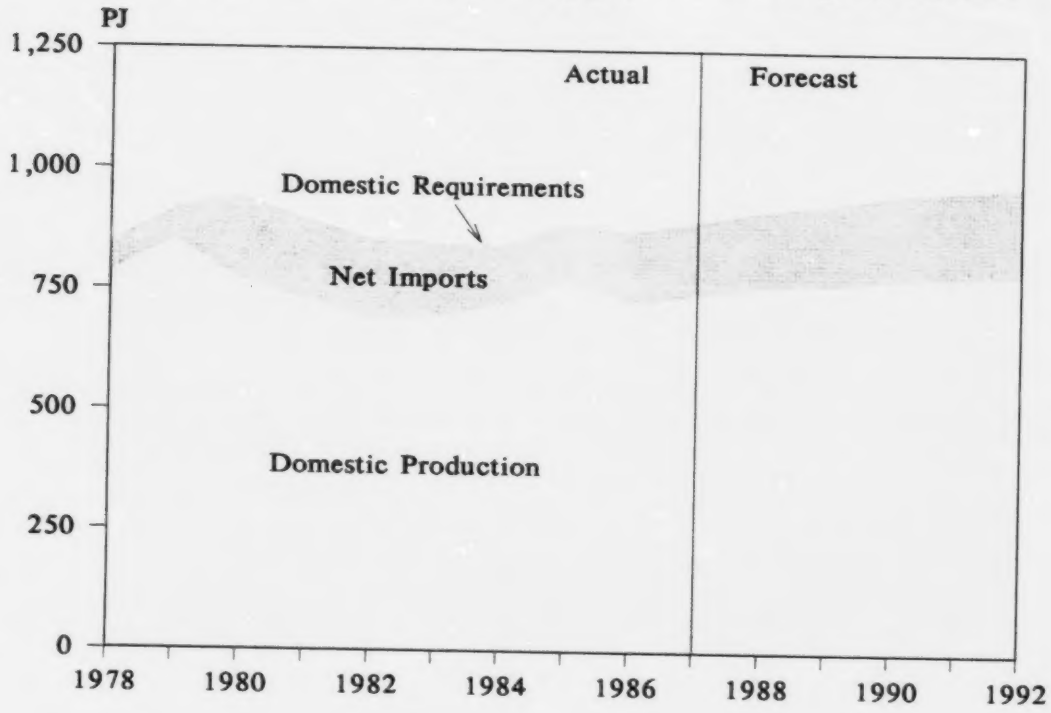
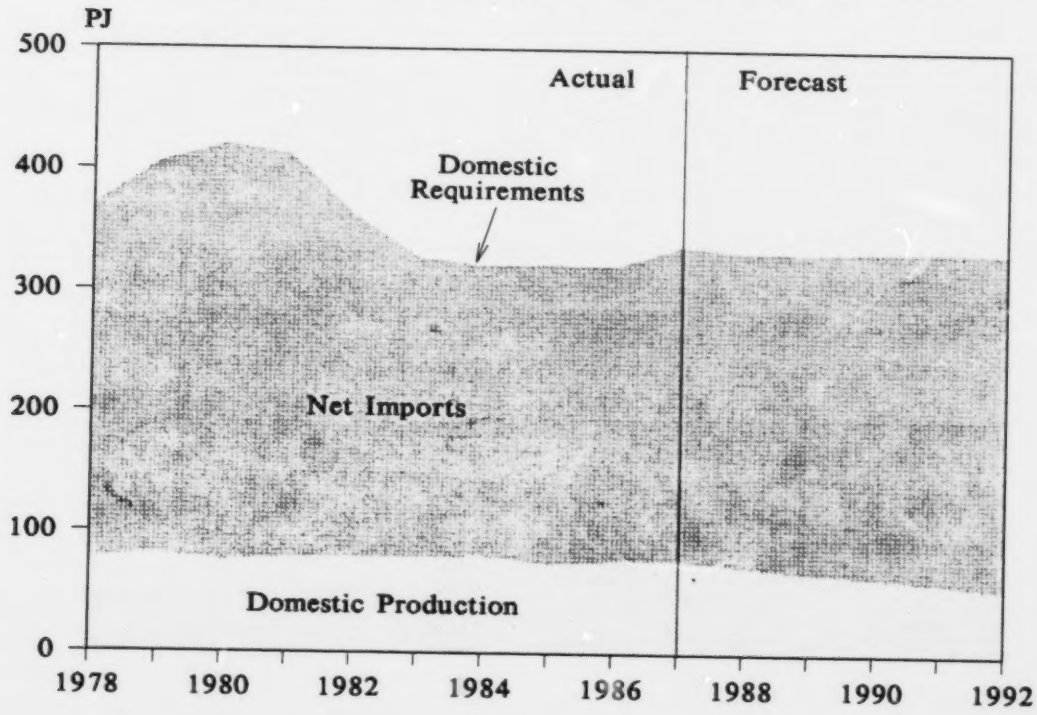


Figure 2.2 : Oil Supply and Requirements



2. Supply and Demand Balance

British Columbia is both a major energy producer and a major energy consumer. The Province is endowed with abundant hydroelectric resources, significant natural gas reserves, vast quantities of coal and a small amount of oil reserves. British Columbia's energy use per dollar of GDP is among the highest of any region in the world, due to the Province's energy intensive industrial base -- pulp and paper, primary metals, mining and petrochemicals.

The Province is a net exporter of el ctricity, natural gas and natural gas liquids, and a net importer of crude oil and products. Figure 2.1 shows that on balance, British Columbia is a net importer of energy -- about 140 PJ in 1987. Growing dependence on imported oil and highly competitive export markets will increase the Province's net import position. New markets need to be developed to take advantage of British Columbia's undeveloped hydroelectric potential and surplus reserves of natural gas.

British Columbia produces about 670 PJ of coal, 99 percent of which is exported. By including coal in the supply/demand balance, the Province would have a net export surplus of about 500 PJ.

The following sections summarize the supply and requirements balances for crude oil, natural gas, natural gas liquids, and electricity.

2.1 Crude Oil and Refined Petroleum Products

A comparison of crude oil requirements and production is shown in figure 2.2. Although total provincial requirements for crude oil are expected to remain constant over the next five years, crude oil production will decline by 28 percent. In 1987, 73 percent of provincial requirements for crude oil were met by imports from Alberta. By 1992, imports are expected to rise to 83 percent of provincial requirements.

Vancouver refinery production of petroleum products is sufficient to meet the requirements of the southern portion of the Province and some exports. The northern and eastern parts of the Province depend on products shipped from Alberta refineries. As the Canadian refining industry continues to rationalize production, the closure of one or more of the Province's refineries may be expected in the longer term.

Figure 2.3 : Natural Gas Supply and Requirements

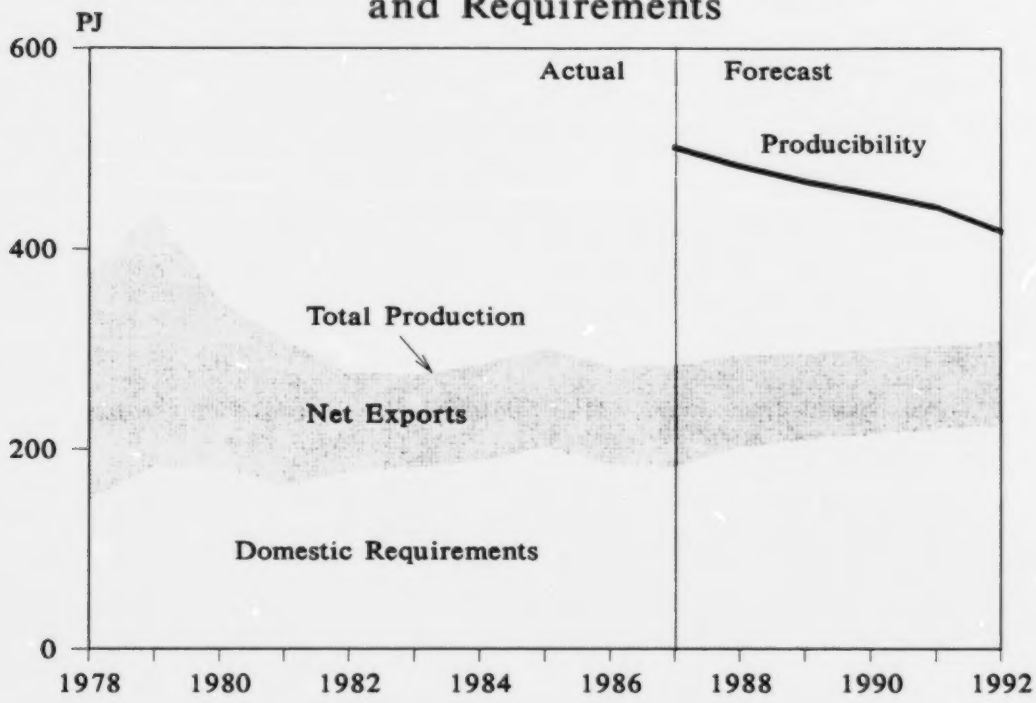
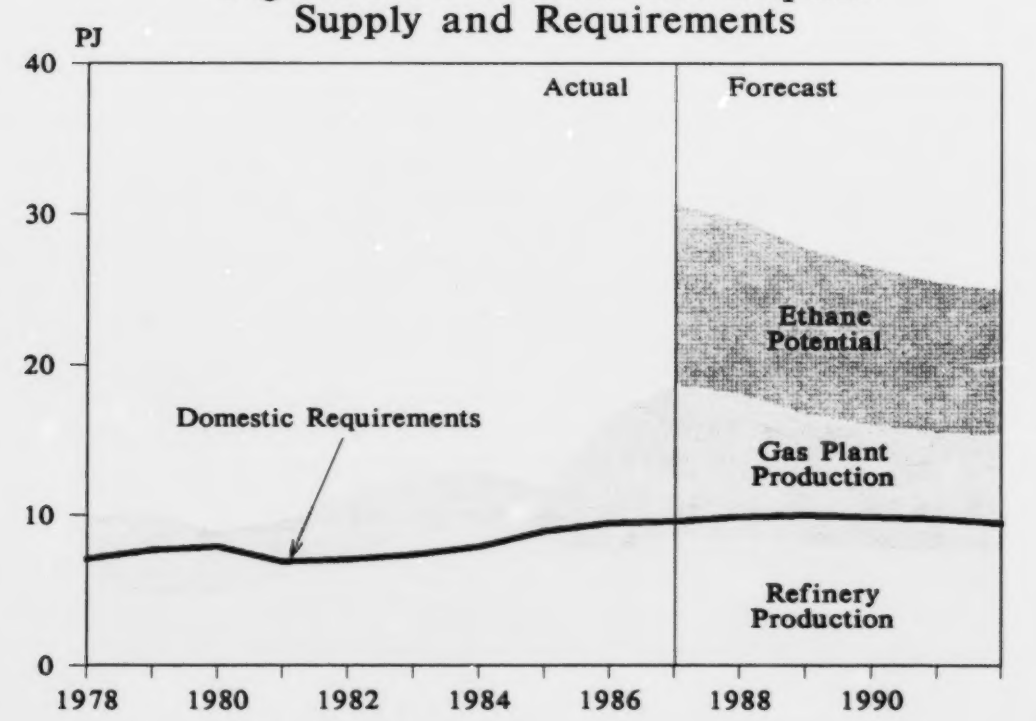


Figure 2.4 : Natural Gas Liquids Supply and Requirements



2.2 Natural Gas

Figure 2.3 compares the total requirements for British Columbia natural gas with the available productive capacity. Because productive capacity exceeds requirements the producibility forecast has been adjusted to allow unused capacity to be carried forward.

In 1987, adjusted producibility exceeded domestic and export requirements by 210 PJ; by 1992 the difference will be reduced to 105 PJ. However, producibility will still exceed projected domestic and export requirements by more than 30 percent.

Table 2.1 shows the results of the Province's natural gas surplus test. The Province has recently revised its surplus procedures, modifying the Reserves Test to protect core market requirements only. Current estimates indicate a surplus of 5.5 EJ in 1987 and 5.3 EJ in 1988.

Table 2.1
NATURAL GAS SURPLUS TEST
EJ

	1987	1988
15 x Core market requirements	1.5	1.7
+ Remaining export commitments:		
Long term contracts	1.7	1.6
Short term direct sales	0.3	0.2
= Total required reserves	3.5	3.5
Remaining established reserves	8.7	8.6
+ Remaining extra-provincial reserves	0.3	0.2
= Total available reserves	9.0	8.8
Surplus	5.5	5.3

2.3 Natural Gas Liquids

Natural gas liquids (NGL) include propane, butane and ethane. NGL are extracted from the natural gas stream at gas plants and from crude oil at refineries. British Columbia currently produces nearly twice as much propane and butane as is consumed in the Province (figure 2.4) and ships the surplus to Alberta and the United States. The production of gas plant propane and butane more than doubled in 1986 following the construction of a deep-cut facility at Taylor. The Taylor plant has also significantly increased the potential for ethane production. Ethane production is currently reinjected into the gas stream, but could add 15 PJ to supply if markets were to be developed.

Figure 2.5 : Provincial Hydroelectric Supply and Requirements

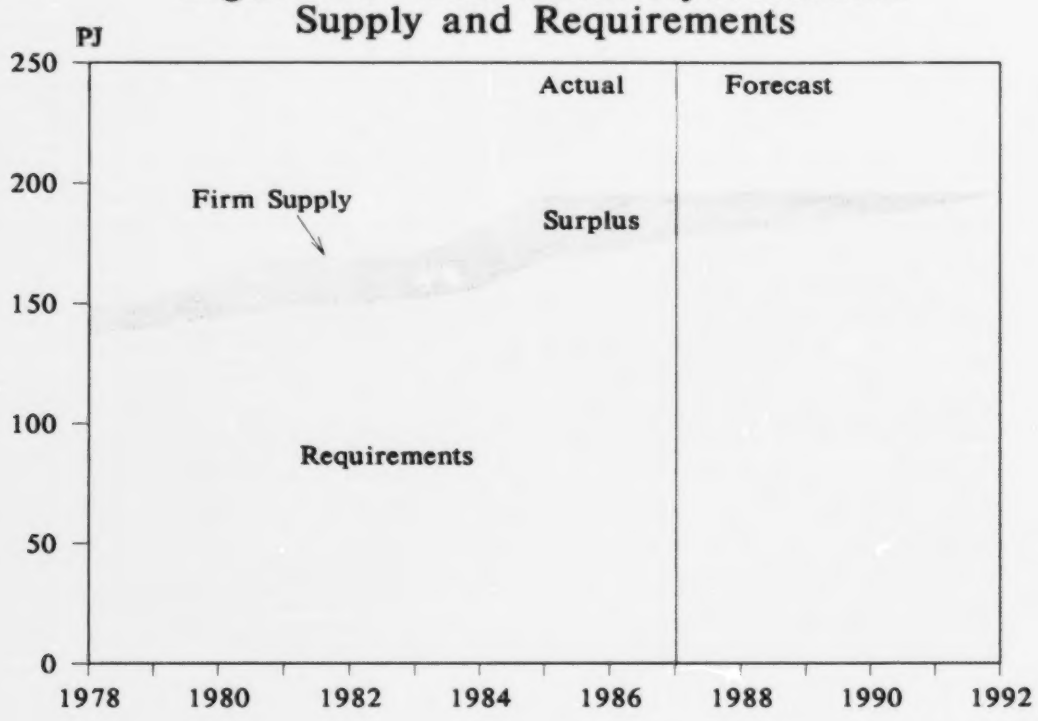
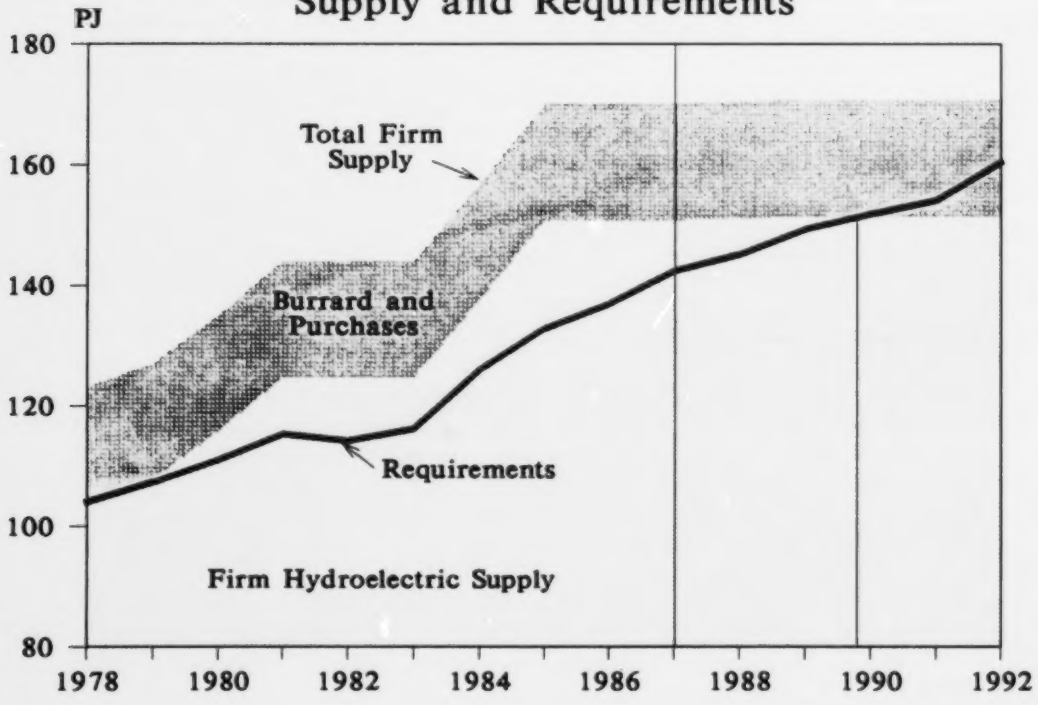


Figure 2.6 : B.C. Hydro Integrated System Supply and Requirements



2.4 Electricity

Electricity requirements in British Columbia are generated from hydroelectric and thermal sources by public and private utilities and industrial establishments. Approximately 95 percent of total requirements are met from hydroelectric generation, the remainder from thermal generation using heavy fuel oil, diesel fuel oil, natural gas, hog fuel and pulping liquors. Over the forecast period, thermal generation from natural gas is expected to increase significantly. By 1992, thermal generation will provide 6.2 percent of total provincial electricity requirements, up from 3.7 percent in 1987.

The provincial supply/demand balance for hydroelectricity is shown in figure 2.5. Firm provincial supply includes the generating capability under critical water conditions of the facilities owned by B.C. Hydro, West Kootenay Power and Light, Cominco, Alcan and other industrial establishments. Primary provincial demand is defined to include only those requirements met from hydroelectric sources. The supply and requirements of electricity from thermal sources are included under the primary fuel used to generate the electricity.

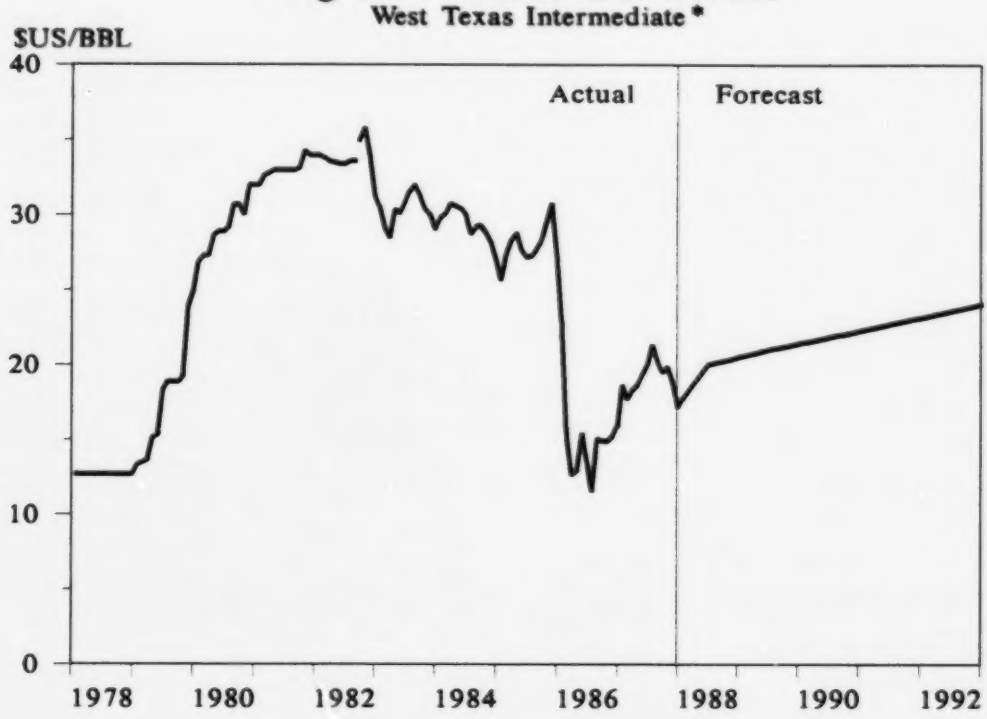
Figure 2.6 shows the supply/demand balance for the B.C. Hydro integrated system. The definitions of both supply and requirements differ from those in figure 2.5. Requirements include integrated system sales, B.C. Hydro's own use, losses, sales to other utilities, and firm exports under the Skagit Agreement. Total B.C. Hydro firm supply includes, in addition to critical water hydro-electric generating capability, an allowance for generation from the Burrard thermal plant and for purchases from other sources in Alberta and British Columbia. The current surplus of firm hydroelectricity, based on long term planning criteria, is projected to be eliminated by the end of 1990. Given current operational constraints, the surplus may be eliminated earlier. Future requirements are expected to be met from secondary energy, the Burrard thermal plant, purchased conservation and purchases from neighbouring utilities and industrial establishments.

2.5 Wood Waste

Wood waste, or hog fuel, consists of bark, sawdust and shavings generated in the production of lumber and other wood products. Hog fuel is used primarily by pulp mills to produce steam for process heat and for the generation of electricity. British Columbia sawmills currently produce roughly twice as much hog fuel as is consumed in the Province. Almost all of the surplus is located in the Interior. Over the forecast period the surplus will decline slightly due to increased demand.

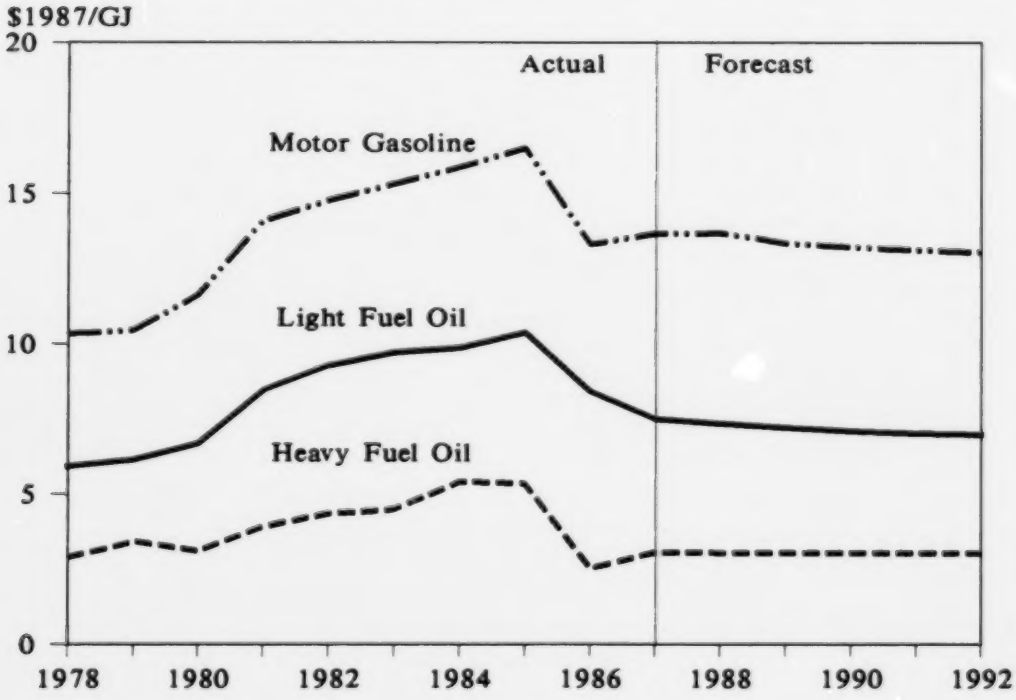
Fig 3.1 : World Oil Prices

West Texas Intermediate *



* From 1978 to 1982 price is for Saudi Light (posted)

Figure 3.2 : Petroleum Product Prices



3. Energy Prices

The accurate prediction of price trends is critical to the forecast of Provincial energy supply and requirements. Changes in relative prices cause interfuel substitution, while increases in the real price of energy result in conservation, technological change, and alterations to the industrial structure of the Province. This section of the report outlines the Ministry's forecast of oil, natural gas and electricity prices.

3.1 Crude Oil

The price of crude oil has fluctuated considerably on world markets in recent years. In 1986 the price of West Texas Intermediate plunged as low as $US 10/bbl before recovering to average $US 15/bbl for the year, down 46 percent from 1985 (figure 3.1). Prices firmed considerably in 1987, averaging $US 4/bbl higher than in 1986.

The path of oil prices over the next few years will depend primarily on the relationship between OPEC production and the world's diminished demand for oil. Despite lower prices, OPEC's market share will be limited by continuing production from non-OPEC countries and by slow growth in world oil demand. A run-up in oil prices is therefore unlikely before the mid-1990's. The price of West Texas Intermediate is expected to average $US 20/bbl in 1988, and to remain constant in real terms through 1992. The cost of crude oil to British Columbia refineries is forecast to track the price of West Texas Intermediate at Chicago, adjusted for transportation, taxes and exchange rate.

There is significant downside risk to this forecast. In late 1987, OPEC production was running well above quota, and unless restrained could result in a fall in prices in 1988. This possibility is examined in section 7.

3.2 Refined Petroleum Products

The prices of refined petroleum products in British Columbia are projected by adding refining costs, provincial and federal consumption taxes, and distribution costs to the cost of crude oil delivered to Vancouver. Heavy fuel oil is the exception to this rule. The price of heavy fuel oil tends to respond quickly and proportionately to changes in crude prices, and has therefore been tied directly to the world oil price forecast.

During the next few years, prices will be kept from rising by low crude costs and competition from natural gas and imported products. In real terms refined petroleum product prices will remain constant or decline slightly (figure 3.2).

Figure 3.3 : Natural Gas Prices

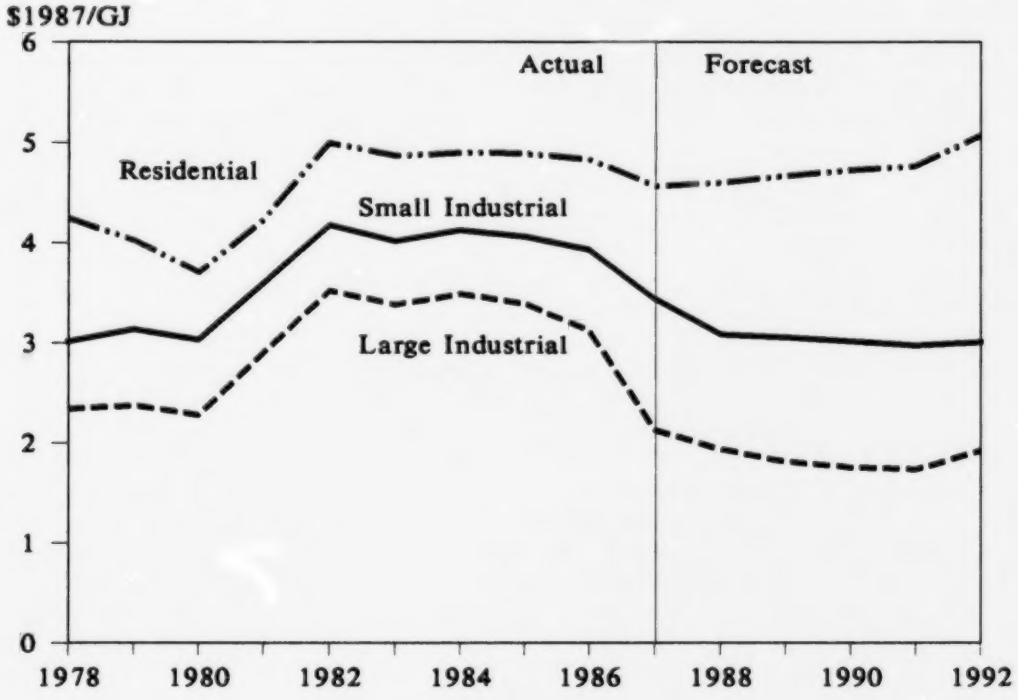
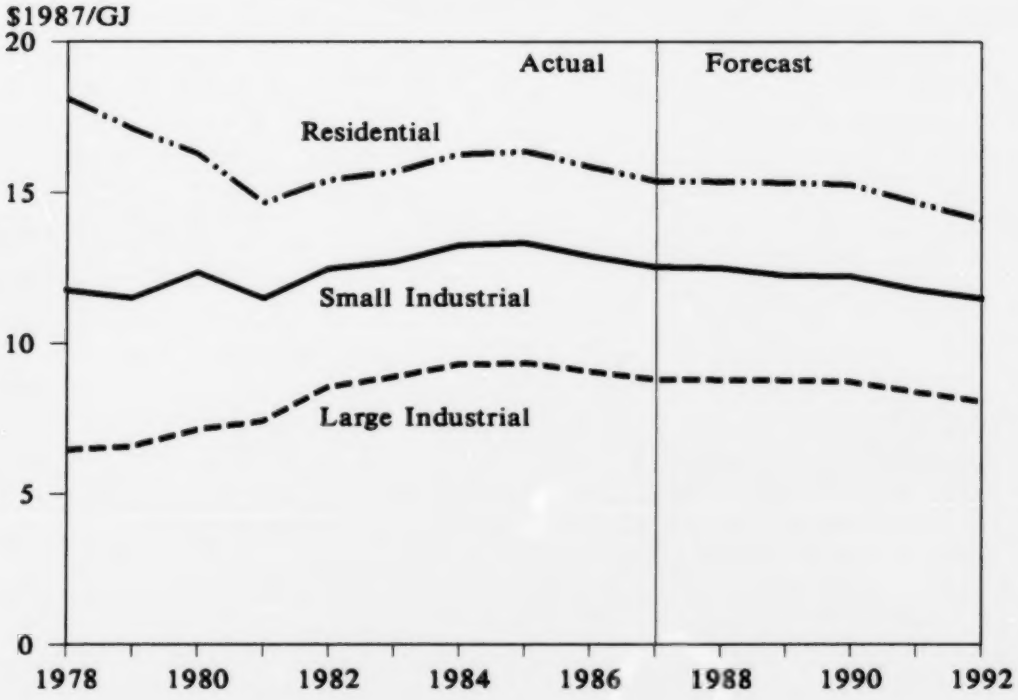


Figure 3.4 : Electricity Prices



3.3 Natural Gas

Until recently, natural gas prices were set by government policy which linked the wholesale price of gas to the refinery acquisition cost of crude oil at Vancouver. The Agreement on Natural Gas Markets and Prices signed in October, 1985, by the Government of Canada and the producing provinces was designed to deregulate domestic gas markets. On November 1, 1986, the British Columbia government ceased setting the price of natural gas. Prices are now determined by negotiations between producers, the British Columbia Petroleum Corporation, Westcoast Transmission Co. Ltd. and the distribution utilities.

The development of new reserves and lower exports to the United States have led to a significant surplus of natural gas in British Columbia. The result has been a significant drop in the price of gas to all British Columbians. Industrial consumers who have arranged to purchase gas directly from producers are enjoying even higher price discounts.

Figure 3.3 shows the course of gas prices over the last 10 years and the forecast to 1992. The market sensitive prices of 1987 are 5 to 30 percent lower than the regulated prices of 1986, depending on the sector. The outlook is for little change in 1988 and a slow upward trend over the next few years. Natural gas prices are expected to firm by 1992 as the North American gas bubble dissipates.

3.4 Electricity

Electricity rates in British Columbia are regulated by the British Columbia Utilities Commission (BCUC). Since 1970, increases in residential rates have generally kept pace with inflation, while industrial prices have grown on average by 2 to 3 percentage points more than inflation. No rate increases have occurred since 1986 and prices paid by some industrial users have been reduced by discounts available under the Critical Industries Act and the Industrial Electricity Rate Discount Act.

The forecast of electricity prices is based on current Government policy which requires B.C. Hydro to increase its revenues sufficiently to achieve an interest coverage ratio of 1.3:1 by fiscal 1990/91. Meeting this target is expected to require nominal increases in electricity rates averaging 3.5 percent in each of the next three years. With growing load and declining costs, no further increases in rates are expected in 1991 and 1992. In real terms, electricity prices will be 8.4 percent lower in 1992 than in 1987 (figure 3.4).

It is possible that exports of interruptible electricity to the western United States will be greater than currently forecast. Increased export revenue could then mitigate the need for any rate increases in the forecast period. This possibility is examined in section 7.

Figure 4.1 : Primary Energy Requirements

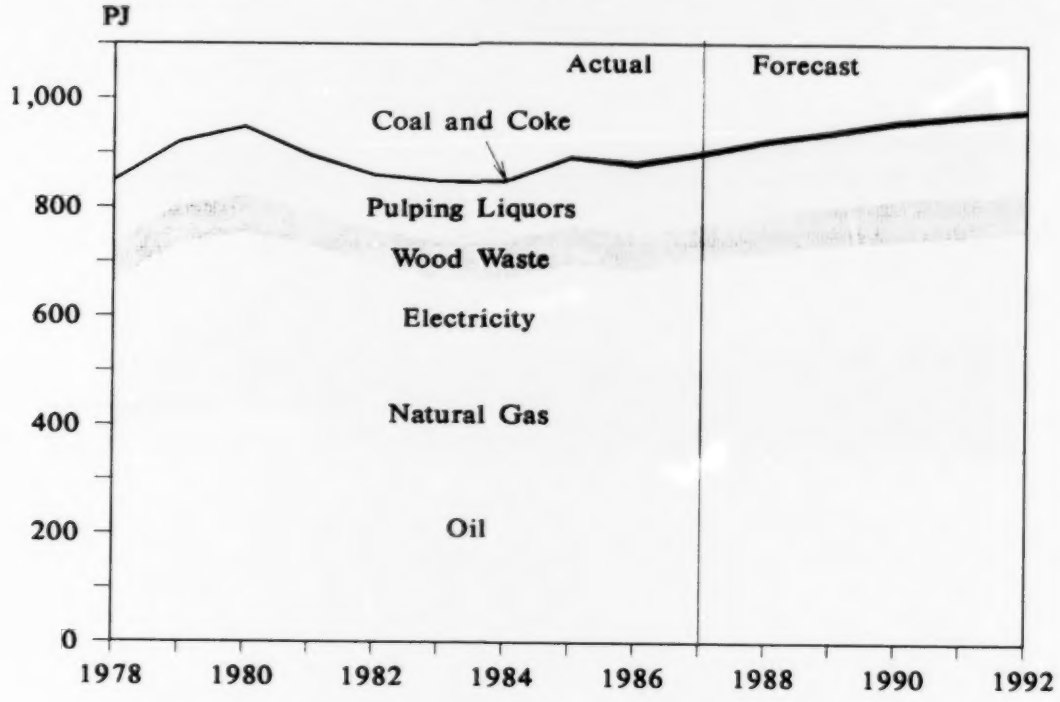
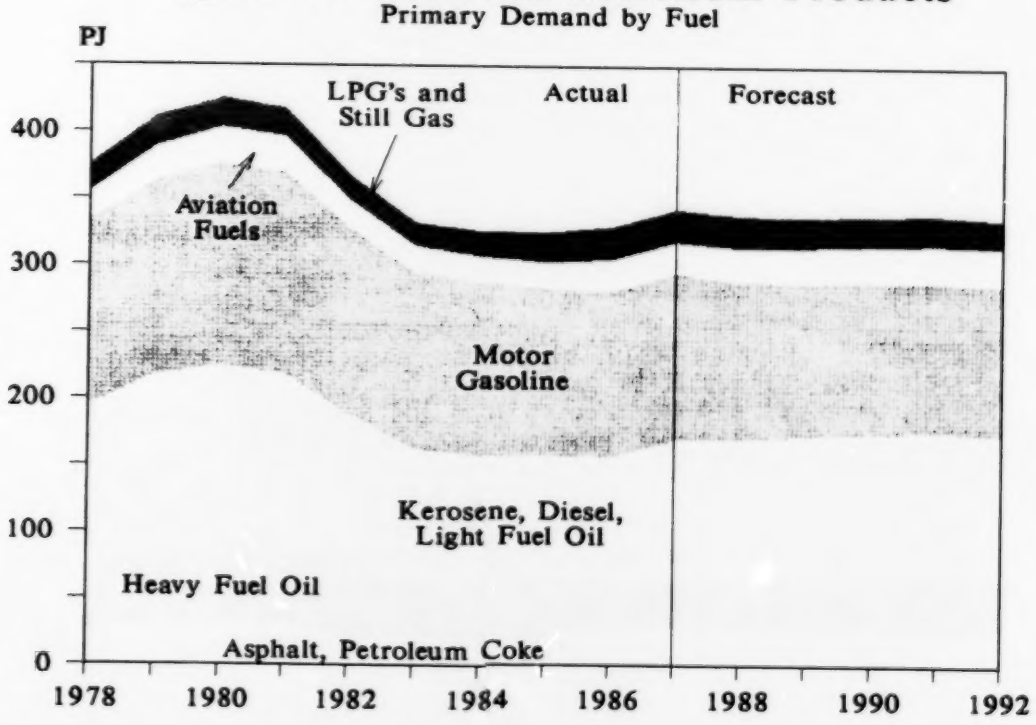


Figure 4.2 : Refined Petroleum Products

Primary Demand by Fuel



4. Primary Energy Requirements

British Columbians used 904 PJ of energy in 1987, and while demand is growing, total requirements are still below the peak reached in 1980. By 1992, total primary demand will be 984 PJ, demonstrating an average annual growth rate of 1.7 percent. Figure 4.1 shows historical and forecast energy requirements by fuel. The largest share is held by oil products, but this is expected to decline over the forecast period. Natural gas, electricity, and other fuels (coal, wood waste, pulping liquors) are all expected to capture increasing shares of total demand. The following sections review primary energy demand by fuel type in more detail.

4.1 Crude Oil and Refined Petroleum Products

Primary requirements for oil include crude oil demand by provincial refineries plus imported petroleum products.

Primary oil demand totalled 343 PJ in 1987 and represented the largest share of primary energy at 38 percent. Conservation efforts in British Columbia have been directed primarily at oil and petroleum products. Oil demand slowed during the late 1970's and then declined for five years in a row following the peak in 1980. In 1986, however, demand increased following the dramatic drop in oil prices, and remained strong through 1987.

The increase in demand for refined petroleum products will not be sustained, since the prices of competing fuels have also fallen. By 1992 oil demand is expected to be 339 PJ, slightly lower than in 1987. Figures 4.2 and 4.3 show oil product demand by fuel and sector, respectively.

Motor gasoline requirements are forecast to continue the decline that began in 1980, as improvements in the average fuel efficiency of the automobile stock continue to offset increases in the number of vehicles and miles driven. Diesel fuel oil demand is expected to show some growth, however, due to increased commercial and industrial activity.

Heavy fuel oil is used almost exclusively by the coastal pulp and paper industry and by the shipping industry. Demand will be strong in pulp and paper due to healthy growth in output and limited coastal hog fuel supplies.

Light fuel oil will continue to be displaced as a heating fuel in the residential and commercial sectors due to the significant price advantage enjoyed by natural gas. However, light fuel oil will maintain sales on Vancouver Island and in mainland coastal regions which currently lack access to natural gas.

Figure 4.3 : Refined Petroleum Products
Primary Demand by Sector

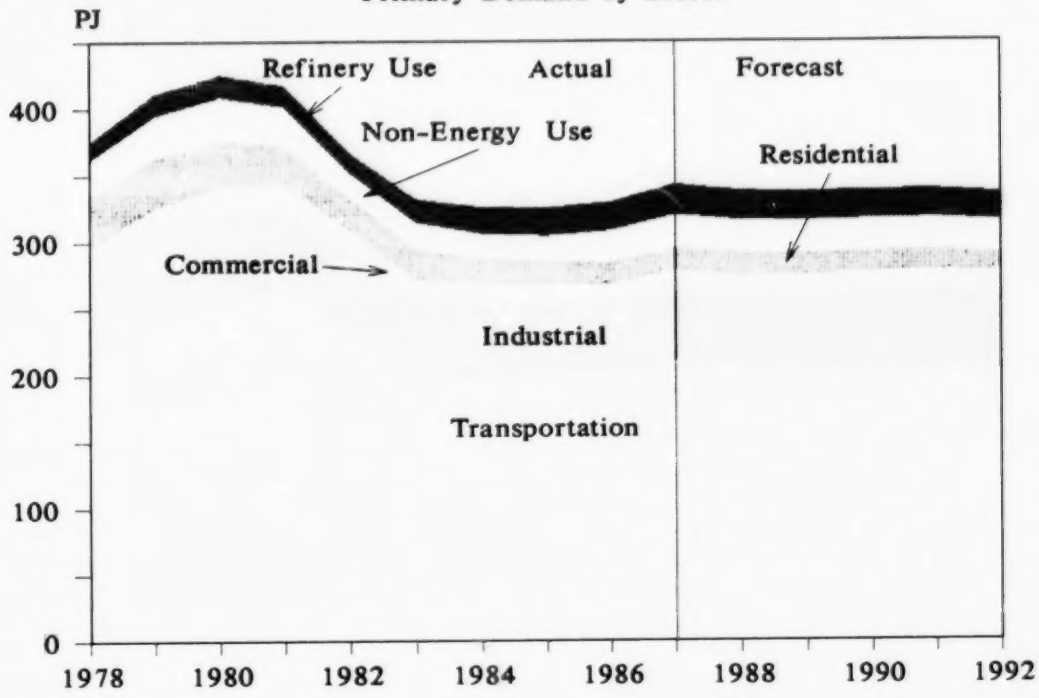
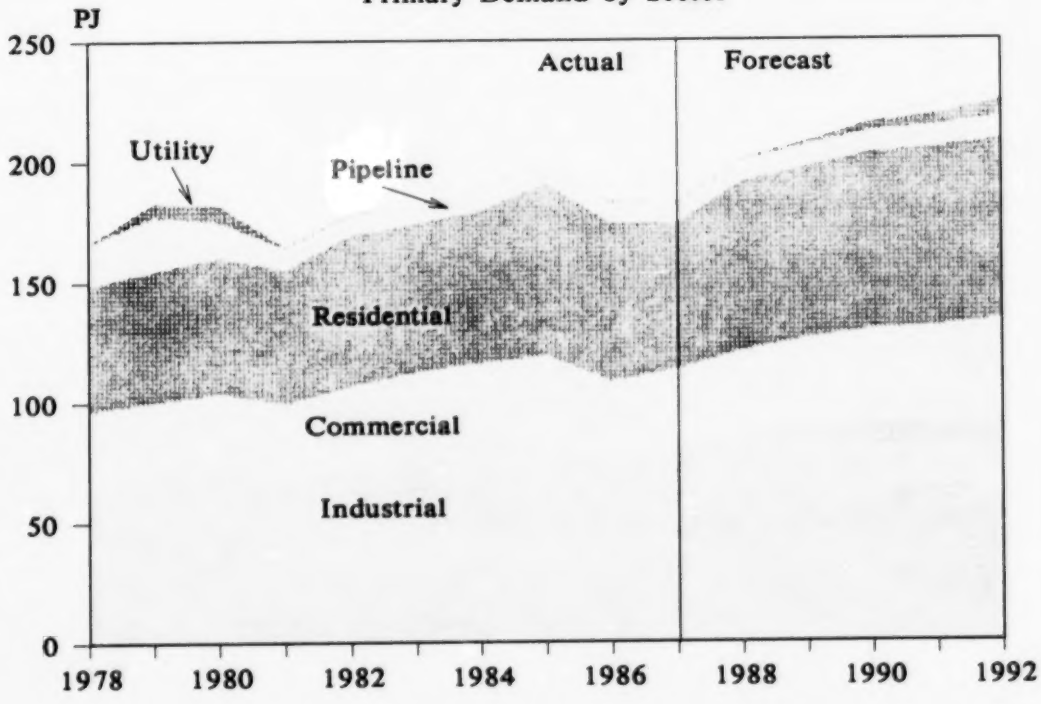


Figure 4.4 : Natural Gas
Primary Demand by Sector



Demand for aviation fuels is expected to remain stable over the next five years, as efficiency gains and higher load factors offset growth in the number of passengers.

Approximately 6 percent of total primary oil requirements are consumed by the petroleum refining industry, largely in the form of still gas (or refinery gas). Still gas contains a significant amount of liquified petroleum gases, which may either be extracted or used as fuel in the refining process. Refinery own-use is expected to remain roughly constant over the forecast period.

4.2 Natural Gas

Primary natural gas demand is defined as the requirements for marketable natural gas processed at provincial gas plants or imported from Alberta.

Primary natural gas demand totalled 184 PJ in 1987, representing 20 percent of total primary energy consumption. During both 1986 and 1987, warm weather caused natural gas requirements for space heating to be lower than normal. Under normal weather conditions, requirements are expected to rebound, and by 1992 natural gas demand will have increased to 226 PJ and its share to 23 percent of total primary demand (figure 4.4).

Deregulation and lower prices have stimulated the demand for natural gas. Under deregulation, large industrial users have been able to negotiate contracts directly with producers, often at substantial discounts. The expanding direct sales market is expected to encourage industrial gas use, particularly in the pulp and paper sector.

Commercial sector energy requirements are expected to increase significantly as economic activity expands. Residential natural gas use is also expected to show steady growth, as natural gas continues to capture a large portion of the new housing market on the mainland. In both sectors, heating oil will continue to lose market share to natural gas, despite lower oil prices, due to the significant price advantage retained by natural gas.

The most rapidly growing component of natural gas demand is expected to be requirements for thermal generation. As the firm hydroelectric surplus diminishes, utilities are expected to make increasing use of thermal generation capacity. Utility demand for natural gas is projected to increase from 0.3 PJ in 1987 to 7 PJ in 1992.

Figure 4.5 : Electricity

Primary Demand

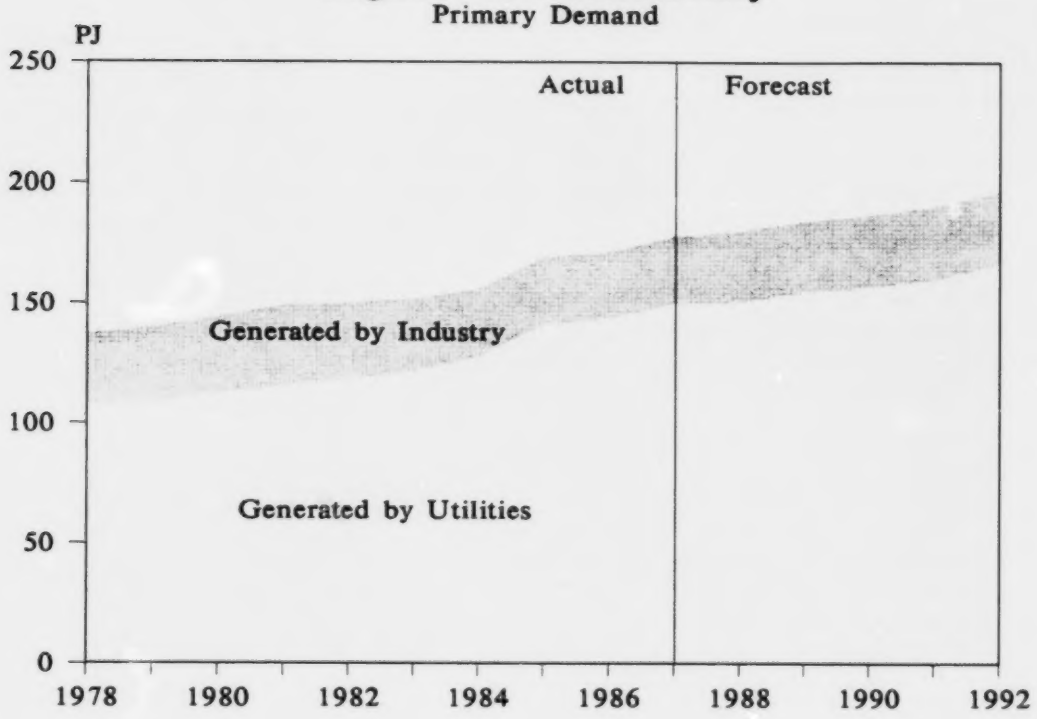
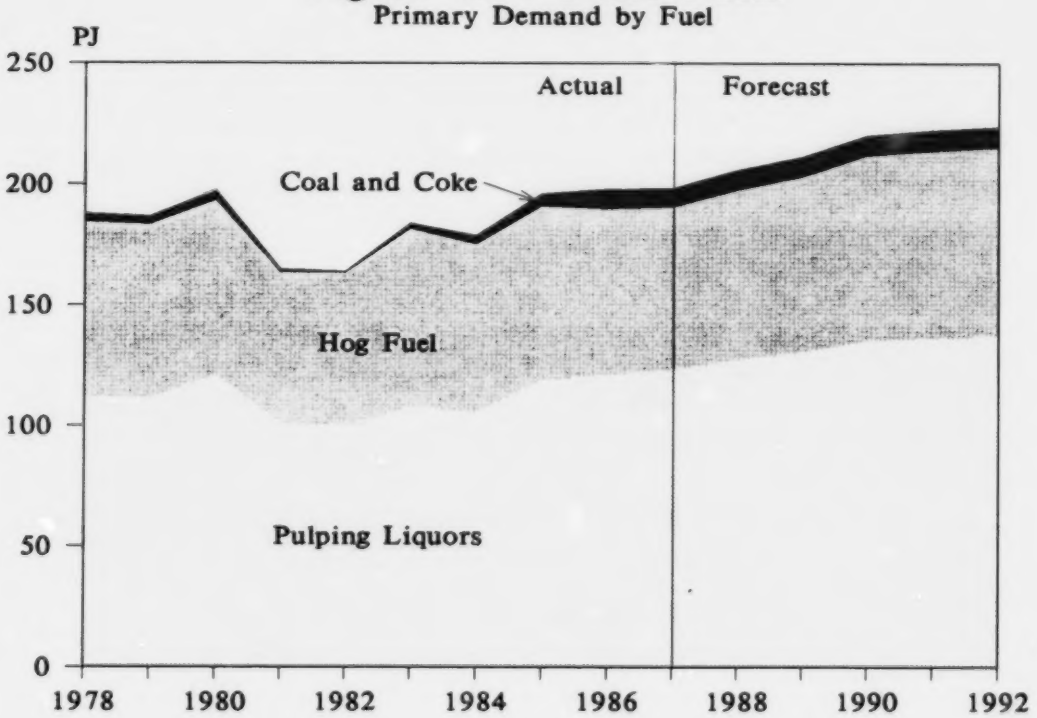


Figure 4.6 : Other Fuels

Primary Demand by Fuel



4.3 Electricity

Primary demand for electricity includes only that generated in hydroelectric facilities. The natural gas, diesel fuel oil and other fuels which are consumed in the thermal generation of electricity are included in the primary demand for each of those fuels.

Provincial hydroelectric requirements in 1987 totalled 178 PJ, representing 20 percent of total energy requirements. Demand is expected to show steady growth in the forecast period averaging 2.0 percent per year. In 1992 requirements will be 196 PJ.

Figure 4.5 shows that virtually all the growth in hydroelectric requirements will be met by utility generation. No new facility construction is required to meet this growth because of existing surplus generating capability created by the completion of the Revelstoke dam in 1984. By 1990, utility hydro generation will have increased by 15 PJ to fully absorb the Province's surplus hydroelectric generating capability.

Less than 20 percent (29 PJ) of hydroelectric requirements are generated by industrial establishments. Of this, 85 percent is used in the smelting of aluminum by Alcan and of lead and zinc by Cominco. Industry hydroelectric generation is expected to grow by less than 0.5 PJ by 1992.

4.4 Coal, Wood Waste and Other Energy Forms

Among the other forms of energy consumed in British Columbia are coal, wood waste, pulping liquors, waste gases and oxygenated fuels. Demand for these fuels totalled 200 PJ in 1987 (figure 4.6) and represented 22 percent of primary energy demand. This proportion is expected to increase slightly, as demand for total 'other' fuels is forecast to grow at 1.9 percent per year over the next five years. This increase is due primarily to growth in the pulp and paper industry, where 85 percent of these fuels are consumed.

Coal consumption represented less than 1 percent of total primary energy requirements in 1987, and is expected to grow only marginally over the forecast period. The use of coal for drying at British Columbia coal mines represents 50 percent of total requirements in the Province.

Wood waste and pulping liquors are used in the pulp and paper industry to produce steam for process heat and for the generation of electricity. Primary requirements for these two fuels represent 21 percent of provincial primary energy demand. This proportion will increase slightly as requirements are expected to grow at 1.9 percent per year.

Small amounts of methanol and ethanol are consumed as gasoline additives, and waste gases are used in the cement industry. These fuels comprise less than 0.1 percent of total primary requirements.

Figure 5.1 : Secondary Energy Requirements

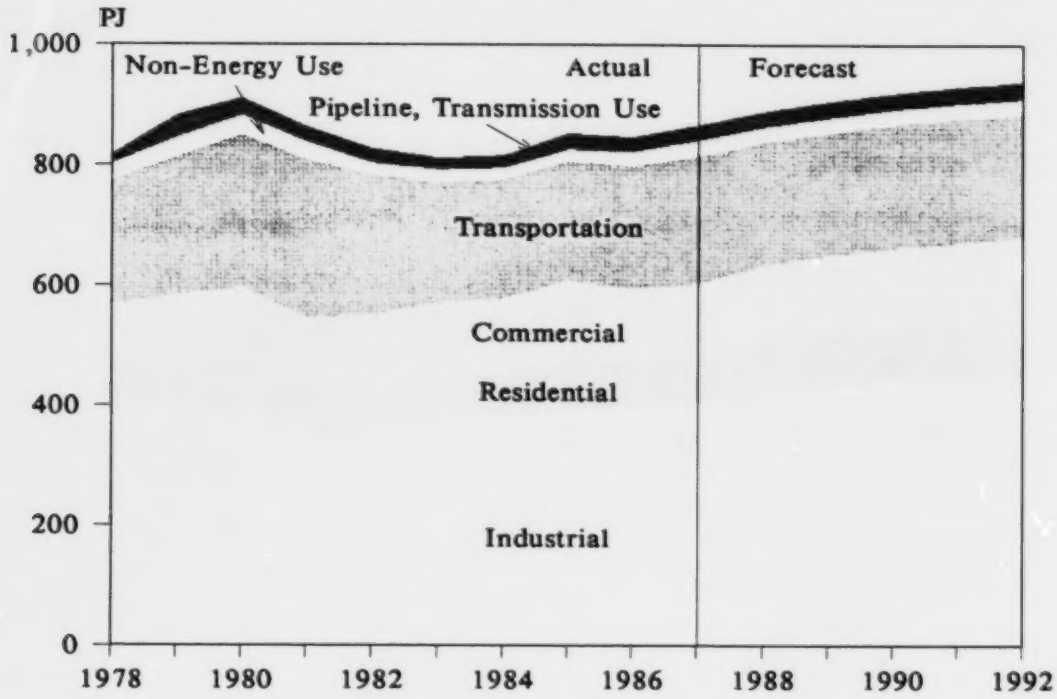
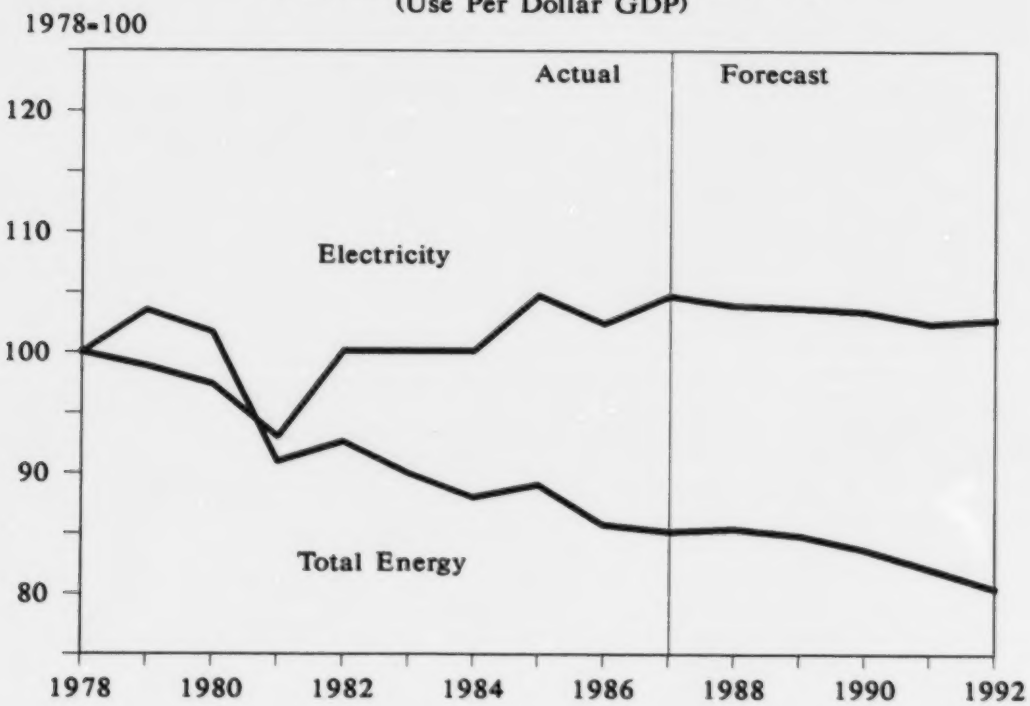


Figure 5.2 : Energy Intensity

(Use Per Dollar GDP)



5. Secondary Energy Requirements

Secondary energy requirements include all energy consumed at the point of use, whether for heating homes and lighting offices or powering industrial boilers and internal combustion engines. Energy used in 'non-energy' applications such as petrochemical feedstocks, asphalts and lubricating oils is also included in secondary requirements, as is energy consumed in delivering energy to customers. Secondary energy differs from primary energy by adjusting for losses in the conversion of crude oil to refined products and fossil fuels into electricity. Since energy is lost in the conversion process, total primary requirements are greater than total secondary requirements. While the concept of primary energy is critical to the calculation of energy supply/demand balances the forecast has been prepared by analyzing the end-use consumption of energy by households and firms. This section of the report examines in more detail the outlook for secondary energy demand.

Total secondary requirements are expected to grow by 1.6 percent per year, from 873 PJ in 1987 to 946 PJ in 1992 (figure 5.1). Industrial sector demand is forecast to grow 2.2 percent per year as a result of a healthy pulp and paper industry. An expanding service sector is expected to mean fairly rapid growth in commercial sector energy requirements. Residential demand growth is expected to lag behind growth in the provincial housing stock due to continuing improvements in household energy efficiency. Transportation sector energy demand is forecast to remain constant, as increased vehicle activity will continue to be offset by improvements in fuel efficiency.

Figure 5.2 shows clearly the impact that conservation has had on energy use in British Columbia -- energy use per dollar of GDP has declined by 15 percent since 1978. Despite lower prices for energy, conservation will continue to affect energy demand through the forecast period. Energy use per dollar of GDP will fall 5 percent over the next five years.

Electricity intensity has shown a quite different pattern, however. The consumption of electricity per dollar of GDP increased slightly during the last ten years as consumers substituted away from fossil fuels and as new applications and electricity intensive industries grew. Electricity intensity is expected to remain at current levels.

Figure 5.3 : Residential Energy Requirements

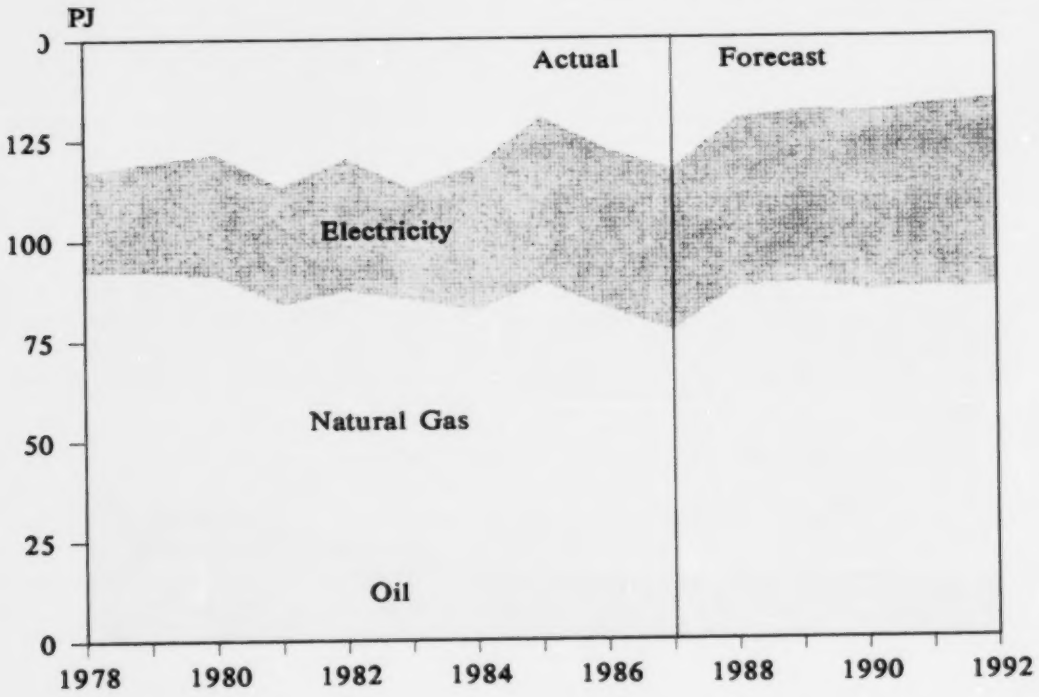
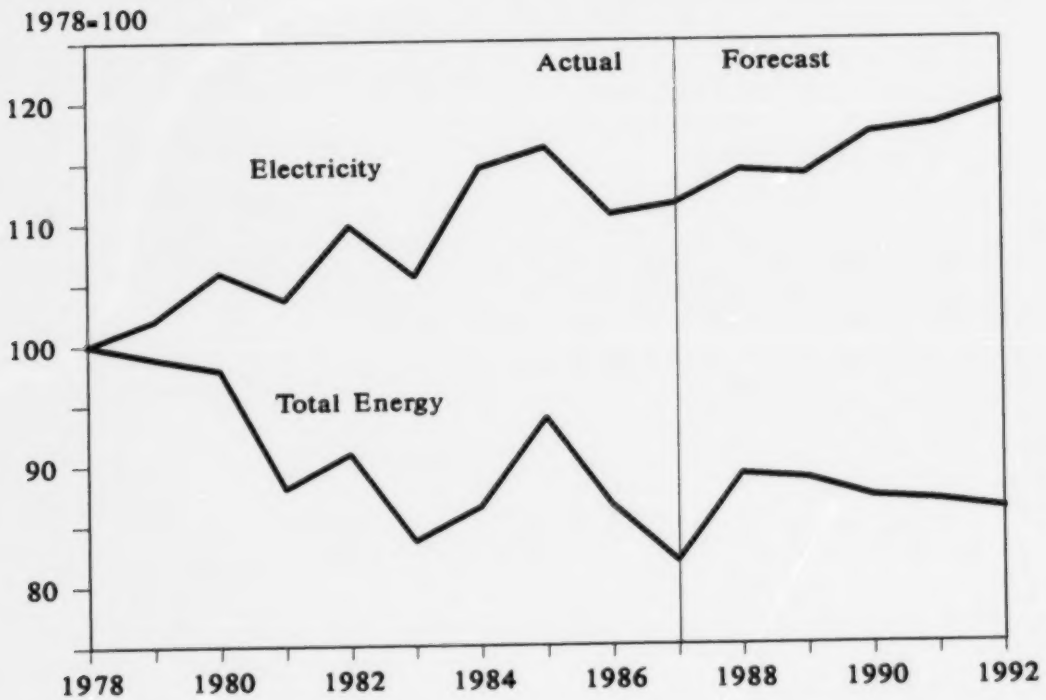


Figure 5.4 : Residential Energy Intensity



5.1 Residential

Households consume energy for lighting, space and water heating, and in appliances. In British Columbia residential energy needs are met primarily from natural gas and electricity, with some light fuel oil consumed in areas lacking access to gas (figure 5.3).

Significant gains in the energy efficiency of homes have been made in the last fifteen years. Higher energy prices, changes to building codes, and government grant programs have greatly reduced the energy requirements of new and existing homes. Average energy consumption per household has declined by more than 10 percent since 1978 (figure 5.4). Household requirements are expected to continue to decrease, although at a slower rate due to lower prices (figure 5.5) and the extent of gains already made. Under average weather conditions, total residential sector requirements are expected to increase 1.4 percent per year, less than the 1.8 percent growth forecast for the housing stock.

Both natural gas and electricity are expected to continue to gain market share at the expense of heating oil. While natural gas is the energy bargain for space and water heating in detached housing, electricity tends to be preferred in multiple-unit developments due to lower installation and metering costs. Light fuel oil will continue to be an important fuel on Vancouver Island and in some mainland coastal regions, but consumption is expected to decline.

Figure 5.5 : Residential Energy Prices
(Adjusted For Efficiency)

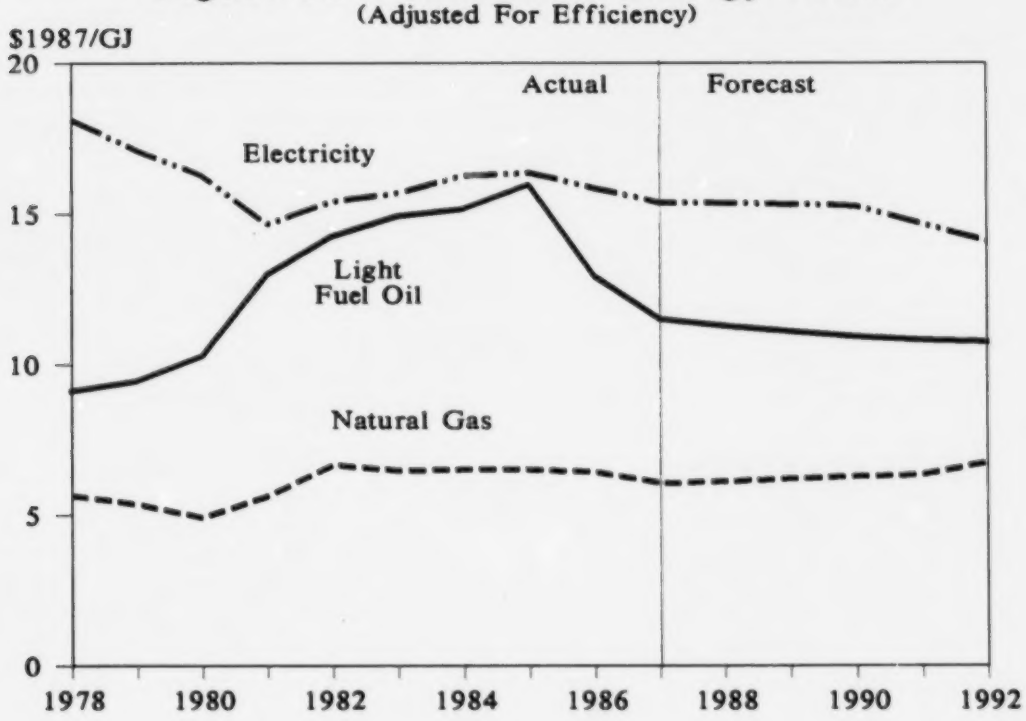


Figure 5.6 : Commercial Energy Requirements

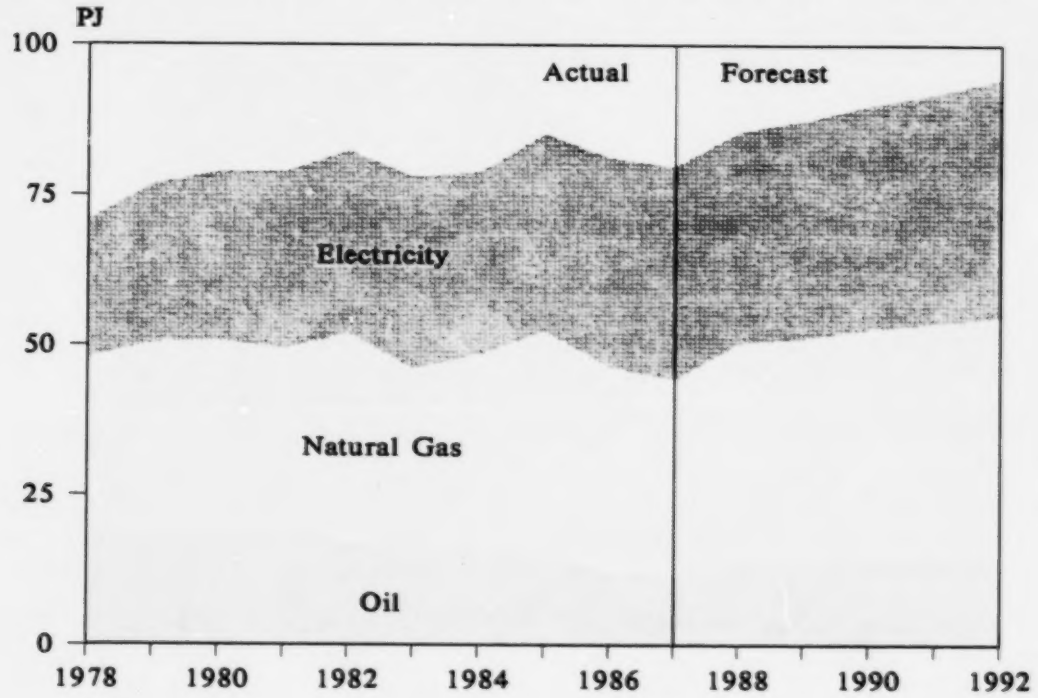
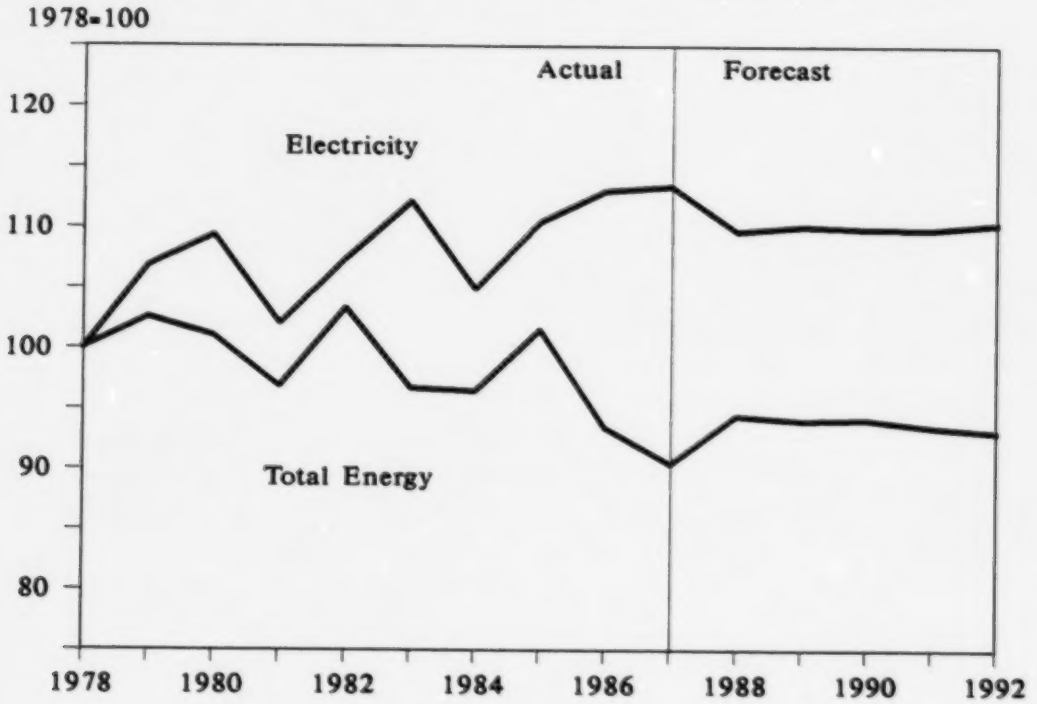


Figure 5.7 : Commercial Energy Intensity



5.2 Commercial

Commercial sector energy demand includes the requirements of government, finance, insurance and real estate, communications, personal and business services, and wholesale and retail trade. Energy requirements in this sector are primarily associated with lighting and space heating.

After a cold 1985 winter, energy requirements were significantly reduced in 1986 and 1987 by warm weather. Under average weather conditions, energy requirements are expected to increase 2.9 percent per year over the forecast period (figure 5.6).

Over the last ten years improvements in the energy efficiency of commercial buildings have resulted in a significant decline in energy intensity (figure 5.7). Although real energy prices are expected to remain low (figure 5.8), a reversal in the conservation trend is not expected. While fewer retrofits will occur, average energy requirements will continue to decline as new, more efficient buildings gradually replace older structures.

The shares of electricity, natural gas and oil products are expected to continue historical trends. Electricity's share is forecast to grow, as conservation continues to be directed primarily at heating requirements. Natural gas is also expected to gain market share over the forecast period, due to its significant price advantage. The share of heating oil has steadily decreased over the last ten years -- lower oil prices will simply slow the decline.

Figure 5.8 : Commercial Energy Prices
(Adjusted For Efficiency)

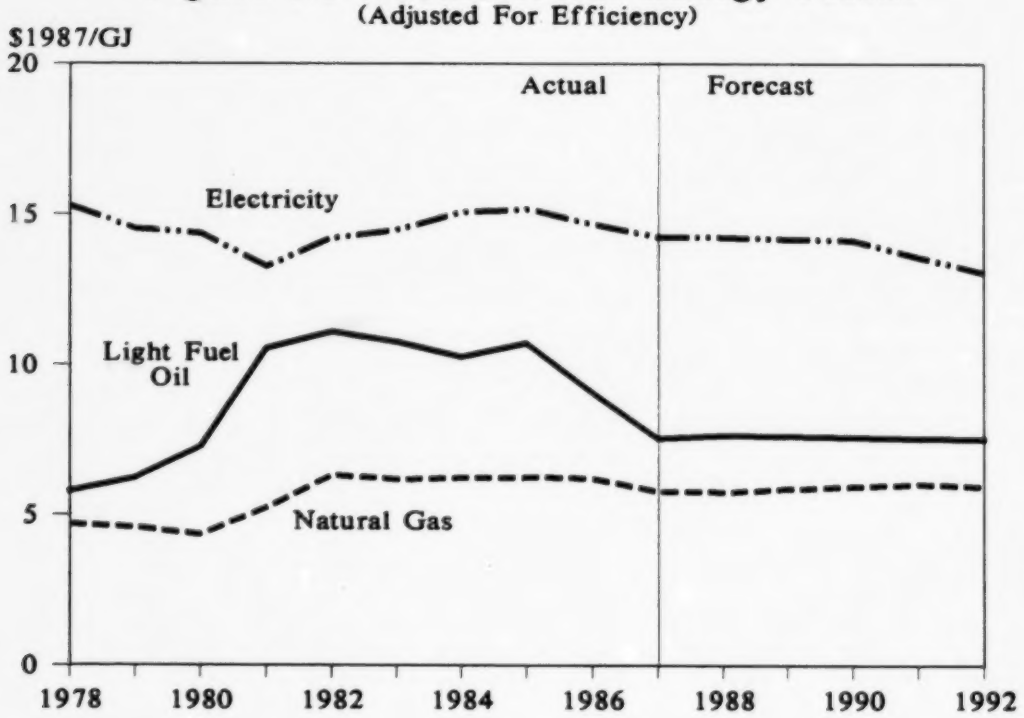


Figure 5.9 : Industrial Energy Requirements by Major Industry

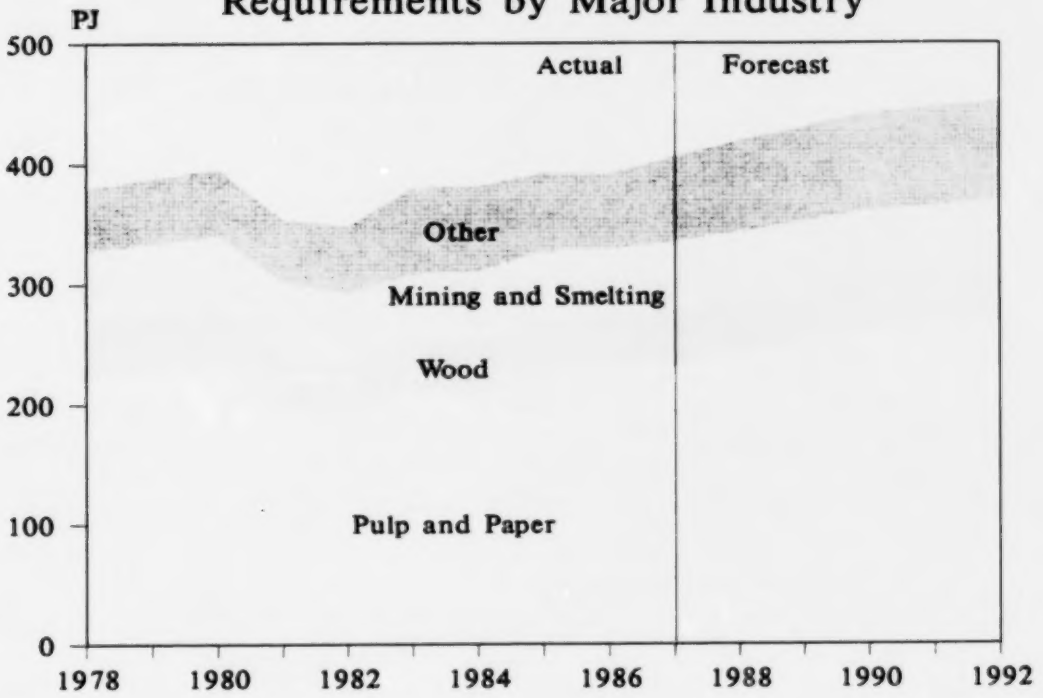
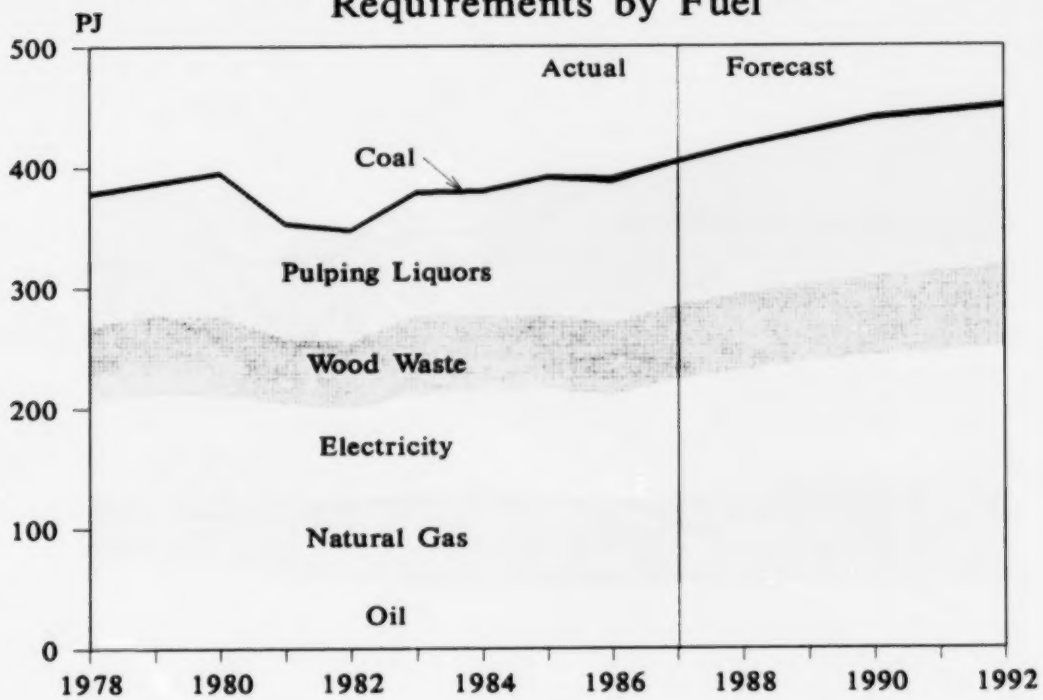


Figure 5.10 : Industrial Energy Requirements by Fuel



5.3 Industrial

Total industrial sector energy demand is forecast to grow from 412 PJ in 1987 to 456 PJ in 1992, at an average rate of 2.1 percent per year. The strongest growth will be shown by natural gas and heavy fuel oil. However, demand growth and energy use patterns vary widely within the industrial sector. Figures 5.9 and 5.10 show total industrial sector energy demand by major industry and by fuel.

Industrial sector energy demand is determined primarily by industrial output, and in particular by activity in the forestry and mining sectors. In the pulp and paper sector, the outlook is very positive, particularly for paper products. Newsprint output is forecast to grow significantly, as is the production of thermo-mechanical pulp and chemi-thermo-mechanical pulp. Several new pulp mills and expansions of existing mills are expected during the next five years. The wood industry is not projected to fare so well. After several years of strong export and domestic demand, production is expected to tail off for several years, due to higher stumpage fees and declining United States and Canadian housing starts.

The outlook for mining is also mixed. High levels of exploration activity in recent years have begun to show results, with several mines either under construction or capable of commencing production within the forecast period. These mines, which are mainly precious metal or multi-metallic deposits, are smaller and have lower energy requirements than the large copper and coal mines which presently account for the bulk of mining energy requirements. No major new developments are included in the forecast, although the large Mount Klappan anthracite project is a candidate for near term development. The 1987 recovery of world mineral prices could result in prices settling out above mid-1980's levels, allowing several existing producers to extend mine lives and preventing production declines which otherwise could have occurred during the 1987-1992 period.

Industrial energy consumption accounted for 47 percent of total secondary energy requirements in 1987. Industry in British Columbia is highly energy-intensive, and while individual industries have made considerable efficiency gains, average industrial energy use per dollar of GDP has remained high over the last ten years (figure 5.11). This has been due primarily to the growing dominance of energy-intensive industries such as pulp and paper, petrochemicals, smelting and mining.

Industrial sector energy prices have declined considerably in real terms since 1985 (figure 5.12), particularly for heavy fuel oil. Deregulation of natural gas prices has allowed industrial users to negotiate contracts directly with producers at significant discounts. Some industrial customers have also obtained substantial discounts on electricity rates under the turbine turndown program, and the Critical Industries and Industrial Electricity Rate Discount Acts. Industrial energy prices are expected to remain low.

Figure 5.11 : Industrial Energy Intensity

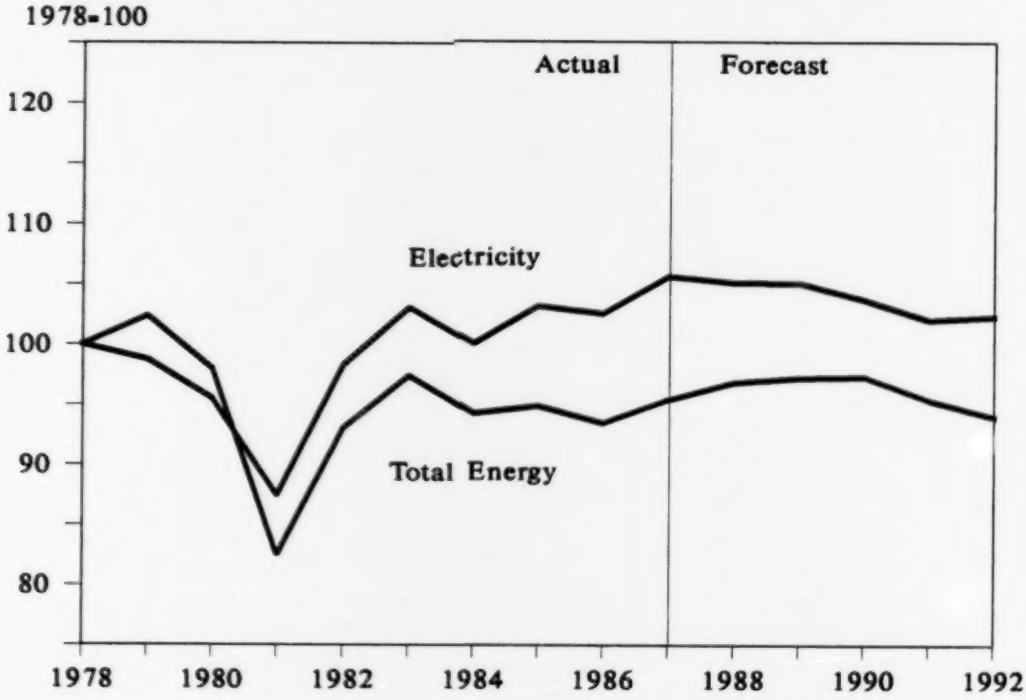
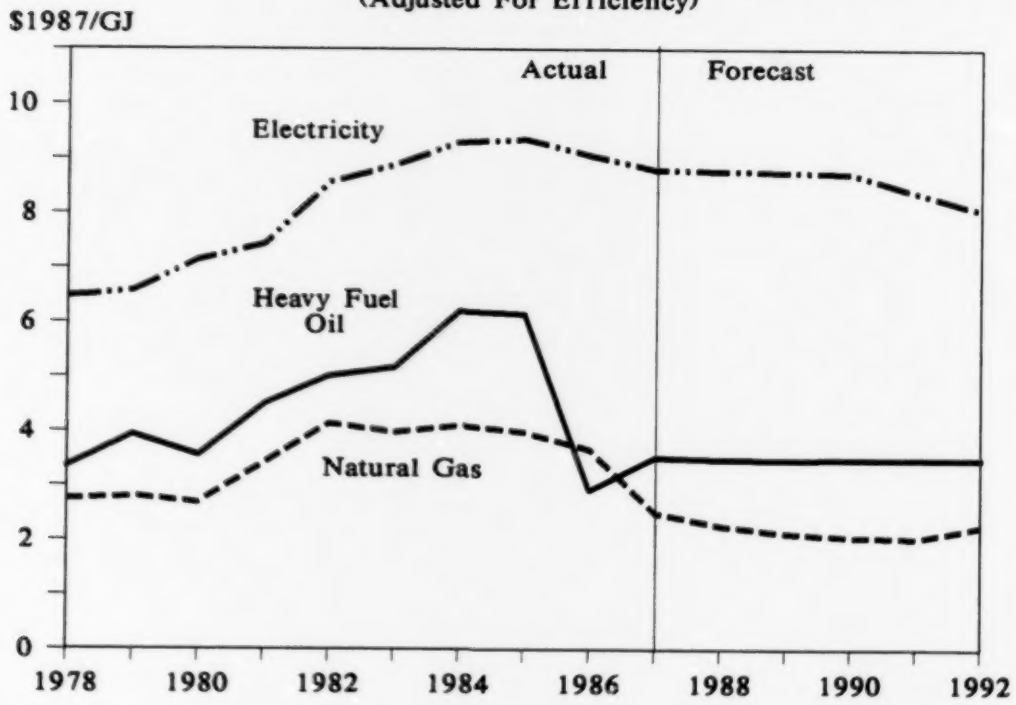


Figure 5.12 : Large Industrial Energy Prices
(Adjusted For Efficiency)



Pulp and paper energy demand accounted for 59 percent of total industrial requirements in 1987, and is forecast to grow 3.1 percent per year. Because production growth will be largely in thermo-mechanical pulp, chemi-thermo-mechanical pulp and newsprint, incremental energy requirements will be met primarily by electricity. Lower prices will stimulate the demand for natural gas in the Interior, but natural gas is unlikely to displace hog fuel because of that fuel's significant price advantage. On the coast, heavy fuel oil consumption will remain high and will increase further as the turbine turndown program ends. A slowdown in lumber production would reduce the current hog fuel surplus and limit the potential for further displacement of heavy fuel oil.

Consumption by the other major industries is expected to show little growth. No increases in smelting capacity are anticipated in the next five years, and energy consumption in the mining and wood products industries should remain flat. Fairly strong demand growth is expected in light manufacturing as that sector expands.

Significant fuel switching has taken place in several industries. Several coal mines have begun using coal to fire dryers, and have reduced natural gas consumption by nearly 4 petajoules. The cement industry, another major energy user, has found several alternatives to natural gas, including coal, petroleum coke, and in one case, waste gases from a nearby municipal dump. Lower natural gas prices will make further investment in alternative fuel systems less attractive, yet the current high degree of fuel substitutability will be retained.

Figure 5.13 : Transportation Energy Requirements by Mode

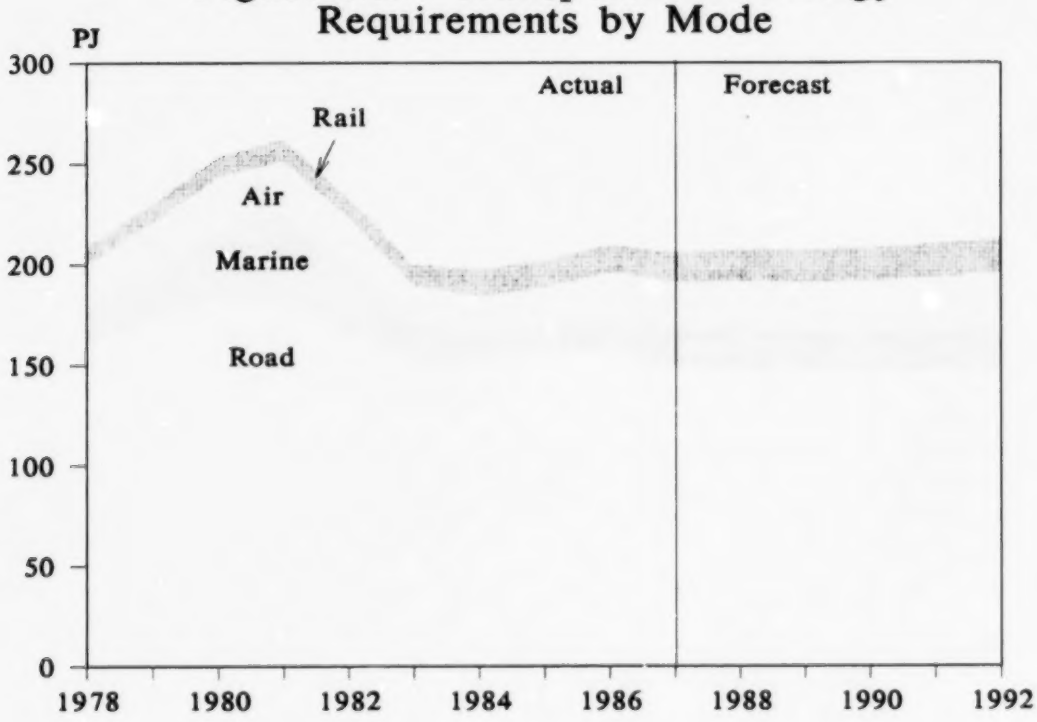
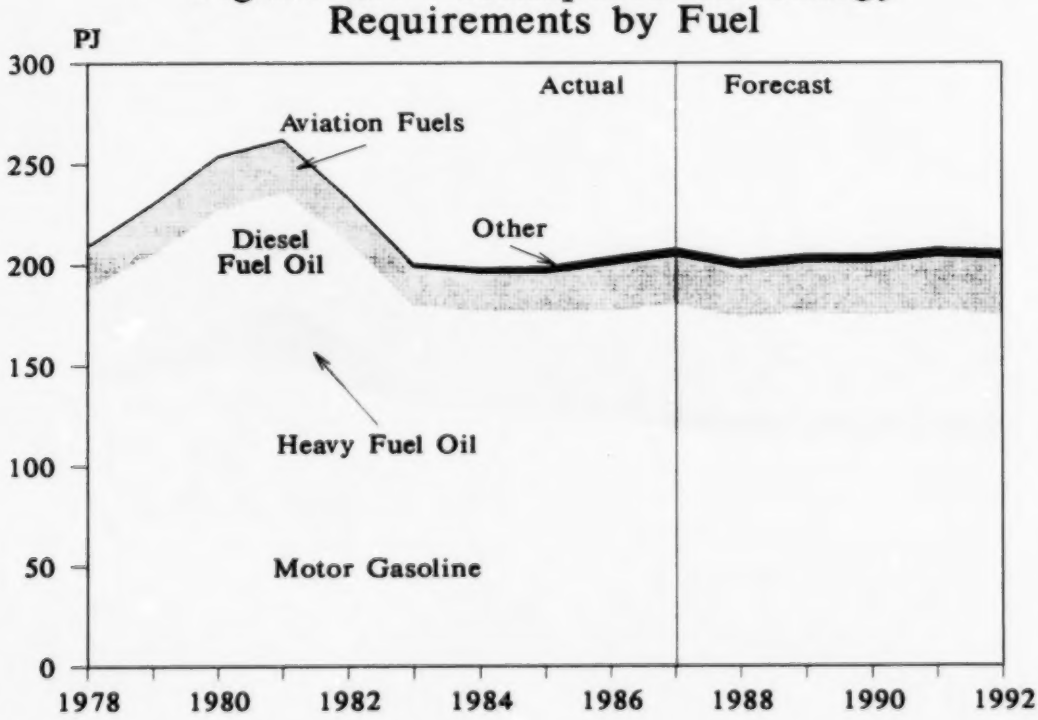


Figure 5.14 : Transportation Energy Requirements by Fuel



5.4 Transportation

Energy used in road, rail, marine and air transport totalled 213 PJ in 1987 and accounted for 25 percent of total provincial requirements. Virtually all (99 percent) of transportation energy requirements are met by refined petroleum products, primarily motor gasoline, aviation fuel, diesel and heavy fuel oil. Small amounts of propane, natural gas and electricity are also consumed, and these fuels are expected to increase their market shares in the forecast period.

Total transportation sector requirements are expected to remain flat at about 205 PJ through the forecast period, as decreases in motor gasoline use are offset by increased demand for diesel fuel oil and aviation fuel. Figures 5.13 and 5.14 show transportation sector energy demand by mode of transport and fuel.

Motor gasoline requirements are expected to fall from 124 PJ in 1987 to 111 PJ in 1992, as the trend towards smaller and more fuel efficient cars continues. Impressive gains in passenger vehicle fuel efficiency have already been made as a result of downsizing, the use of lighter materials, and other technical innovations. Because motor vehicles in British Columbia may last fifteen to twenty years, the adjustment to higher prices begun in the 1970's is not yet complete. The fuel efficiency of the average vehicle is expected to improve by 2.5 percent per year over the forecast period. Over the same period, the vehicle stock is expected to increase by 1.8 percent per year.

Diesel fuel oil consumption by trucks and passenger vehicles is expected to remain flat at about 28 PJ while the consumption of alternative fuels such as propane, compressed natural gas, and methanol/gasoline blends will show some growth. By 1992, the demand for alternative fuels will total 4 PJ, 3 percent of total road transport requirements.

Rail transport requirements for diesel fuel oil are expected to remain constant at about 12 PJ throughout the forecast period, as little growth is anticipated in shipments.

Marine sector requirements for both diesel and heavy fuel oil increased significantly in 1987, but are not expected to show further growth. The demand for heavy fuel oil tends to fluctuate considerably from year to year, due to varying shipments and the possibility of bunkering at a number of West Coast ports. Diesel fuel oil is consumed primarily by the coastal fishing and forestry industries, which are not expected to show significant growth.

Requirements for aviation turbo fuel should grow steadily from 22 PJ in 1987 to 27 PJ in 1992, demonstrating average annual growth of 4.1 percent.

Figure 6.1 : Crude Oil Production

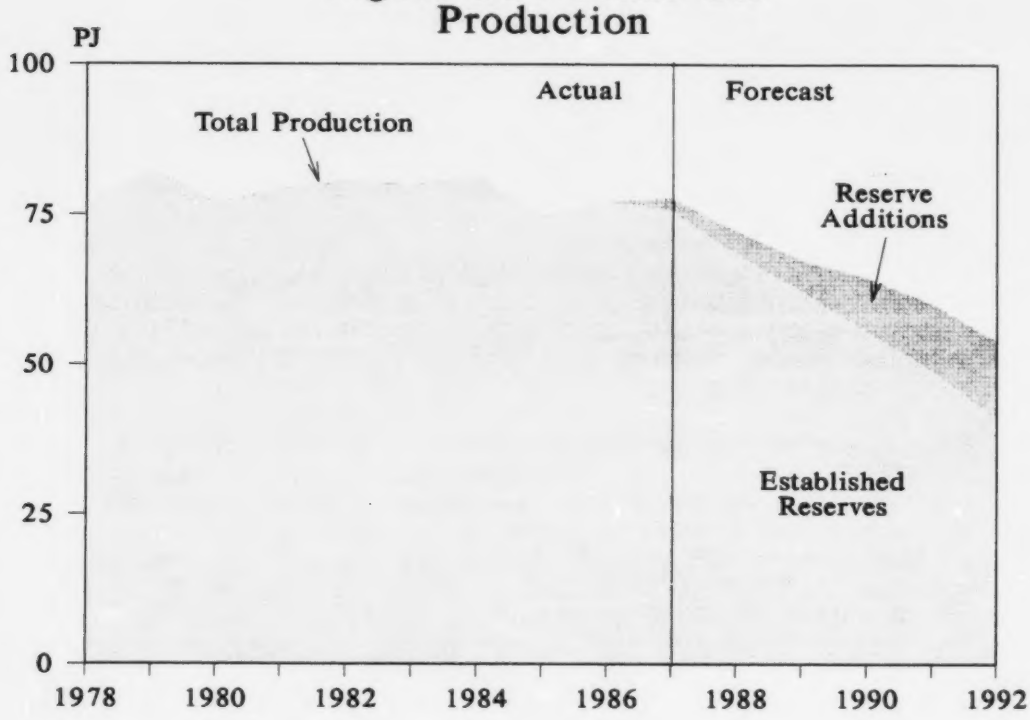
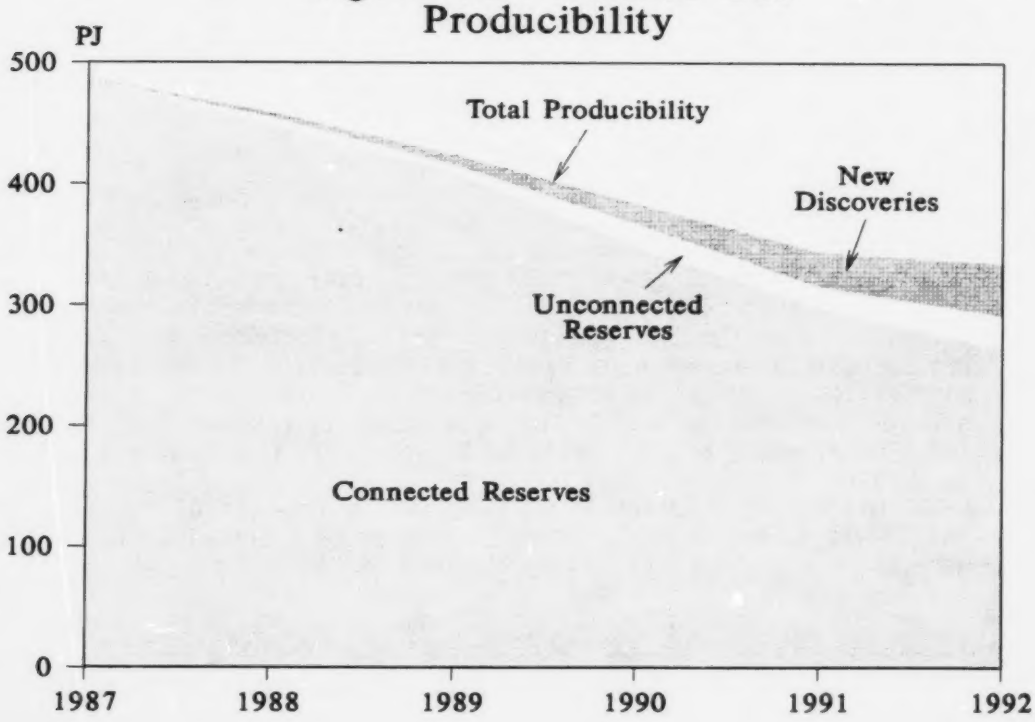


Figure 6.2 : Natural Gas Producibility



6. Energy Supply

This section outlines the production capability of the Province's indigenous energy resources. The Province relies on Alberta to supply the majority of its crude oil requirements. Production from the North East British Columbia oil fields is constrained only by producibility. Refineries supply product requirements in the southern portion of the Province and export small amounts to the United States.

Electricity consumed in British Columbia is supplied from hydroelectric projects and from the combustion of fossil fuels. The supply of natural gas depends on the rate at which gas is produced from connected reserves. Reserves depend on the level of exploration and development activity.

6.1 Crude Oil and Refined Petroleum Products

The oil supply forecast represents aggregate producibility from established reserves and from anticipated new discoveries. Infill drilling, supported in recent years by a royalty holiday, has sustained production from British Columbia's oil fields. However, producibility is expected to decline unless a major new field is discovered. Three major pools (Boundary lake, Eagle and Eagle West) produce 60 percent of British Columbia's total production and are now entering a decline phase. The heavy oil development at Desan will be delayed into the mid 1990's because of persistent low oil prices. While there is significant potential for enhanced oil recovery, production before 1992 may require royalty relief. Crude oil production is expected to decline from 78 PJ in 1987 to 54 PJ by 1992 (see figure 6.1).

The production of oil products refined in British Columbia is expected to remain relatively constant over the forecast period. Refineries are expected to maintain high rates of capacity utilization by exporting surplus product.

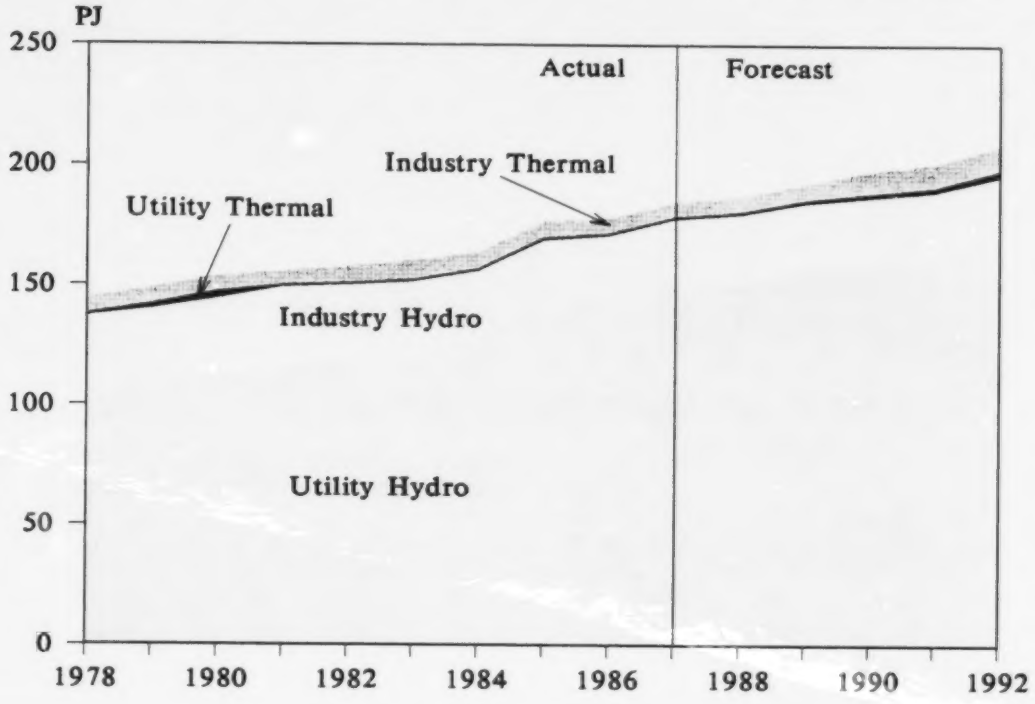
6.2 Natural Gas

As of December 31, 1986, British Columbia had 8.1 EJ of remaining established reserves. Of these, 5.6 EJ were connected and during 1987 provided maximum producibility of 490 PJ.

Although there has been surplus producibility in British Columbia's gas fields, peak day producibility has increased 6 percent since 1985 due to the addition of compression, the drilling of infill wells and the tieing-in of Deep Basin and Sikanni Reserves.

Figure 6.2 shows marketable natural gas producibility. Maximum annual producibility from connected reserves is expected to decline by 11 percent per year until 1992. The decline in producibility will be slowed somewhat by the tieing-in of unconnected reserves and reserves additions.

Figure 6.3 : Sources of Electricity Generation



The rate at which reserves are added is based on drilling and exploratory activity. Expectations of improving markets and a government royalty holiday could result in 675 new wells being drilled by 1992, which would add about 1.7 EJ to reserves and enhance producibility by 15 percent.

6.3 Electricity

The Province's electricity supply is produced from hydroelectric and thermal generation facilities which are owned by public and private utilities, and industrial establishments.

Hydroelectric generation accounts for 96 percent of all generation of which 82 percent is produced by utilities and the balance by industrial establishments (figure 6.3). Electricity consumed in remote areas of the Province is typically generated from diesel generators.

B.C. Hydro is the largest supplier of electricity in British Columbia, generating 124 PJ (78 percent) of Provincial requirements. Cominco, Alcan and West Kootenay Power and Light (WKPL) also provide significant quantities of power. The only new facility addition expected in the forecast period is the proposed 140 MW Gas Turbine to be operated by WKPL starting in 1989.

Figure 7.1 : Low Oil Price Case
Change in Oil Demand, 1992

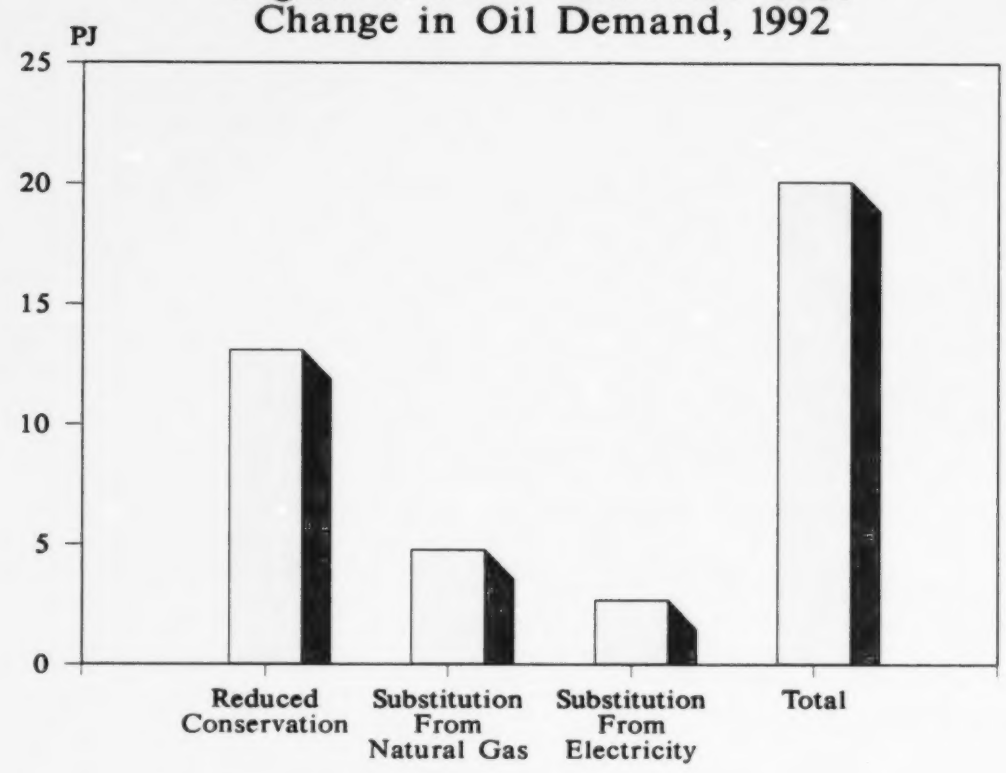
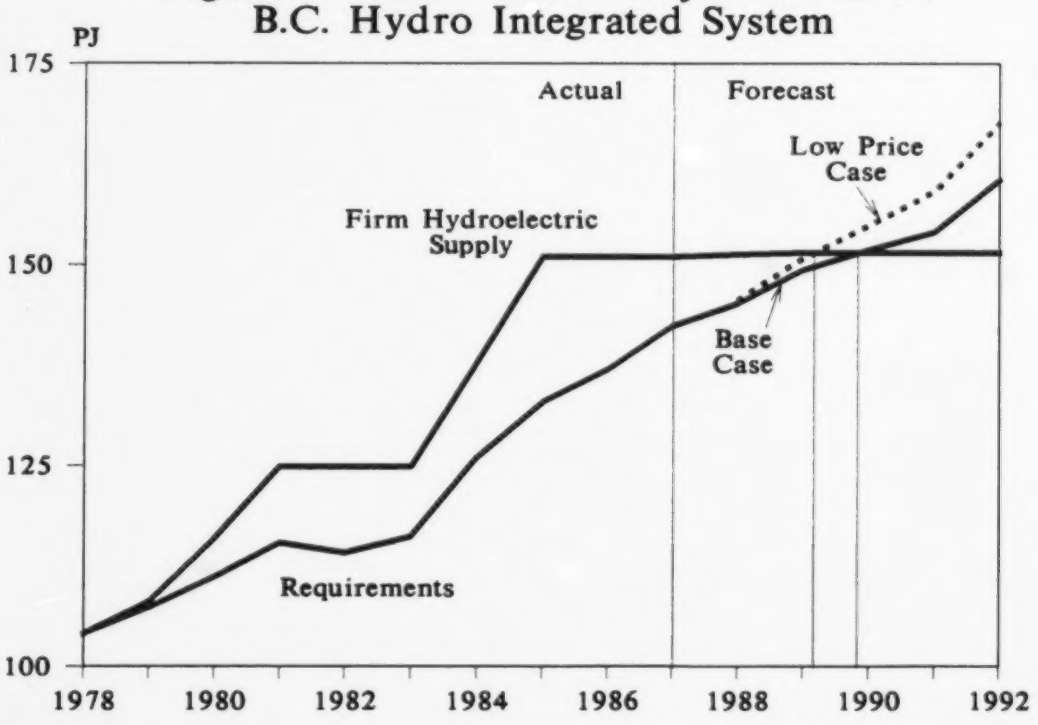


Figure 7.2 : Low Electricity Price Case
B.C. Hydro Integrated System



7. Forecast Sensitivities

The forecast update presented in this report represents the Ministry's assessment of the most probable path of provincial energy requirements and supply over the next five years. However, events in world markets and in British Columbia could significantly alter the outlook. The following sections examine the impact of three alternative scenarios.

7.1 Low Oil Price Case

The base case forecast assumes that OPEC will be able to control member production enough to avoid a sustained drop in prices but will be prevented by market conditions from driving prices up significantly in the next five years. In recent months, however, OPEC production has exceeded nominal quotas by as much as two million barrels per day, making a price decline in 1988 a very real possibility. This scenario examines the impact of oil prices falling to $US 16/bbl in 1988 and remaining constant in real terms to 1992.

Lower oil prices would have a significant impact on Provincial energy use, and particularly on the demand for refined petroleum products. Oil demand is 6 percent (20 PJ) higher in 1992 than in the base case forecast (figure 7.1). Of this, 8 PJ is obtained at the expense of electricity and natural gas which gain less market share than in the base case over the forecast period. The balance (13 PJ) is a reduced conservation effect brought about by lower prices.

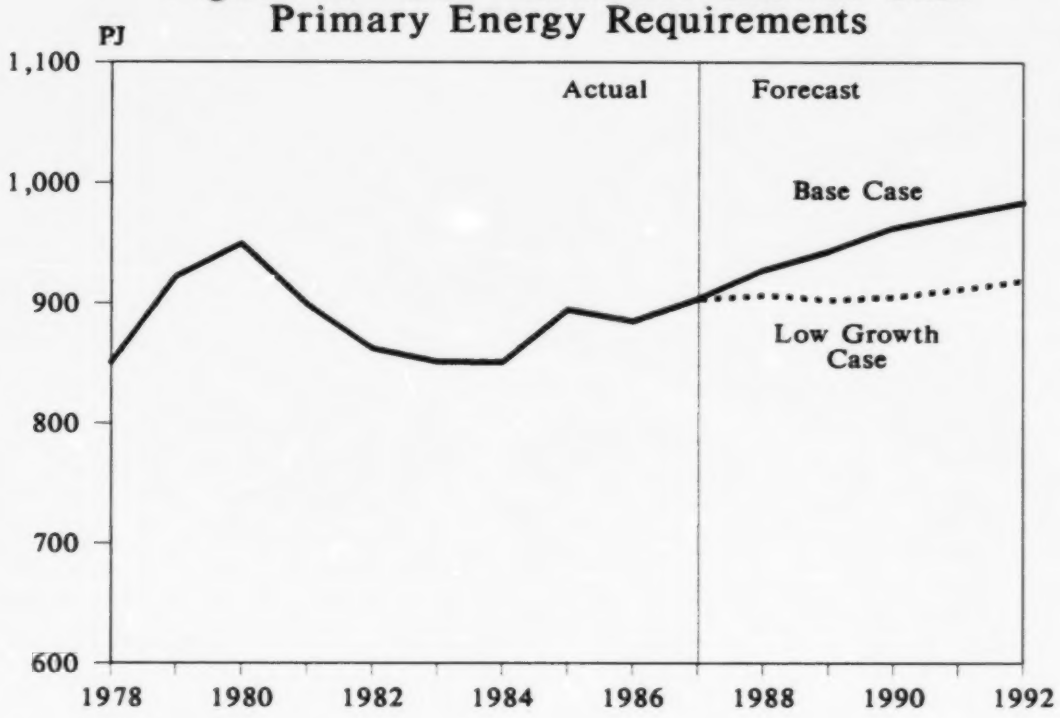
The conservation effect is stronger than the substitution effect because oil usage is dominated by the transportation sector in which there is virtually no fuel substitutability. Because many industries are capable of switching easily between natural gas and fuel oil, low oil prices have a significantly greater impact on gas demand than on electricity demand.

7.2 Low Electricity Price Case

Electricity prices in British Columbia are related to the revenue requirements of B.C. Hydro. Sales of interruptible electricity to the United States also affect prices by reducing the revenue required from domestic sales. It is possible that export revenues will be higher than currently anticipated, allowing B.C. Hydro to meet its financial targets without increasing prices. Under this scenario domestic electricity prices would remain constant in nominal terms, showing a 17 percent real decline by 1992.

The low electricity price scenario indicates that secondary electricity demand would grow at 3.1 percent per year relative to the 2.5 percent forecast in the base case. Three-quarters of this impact is attributed to weaker conservation effects and one-quarter to substitution away from fossil fuels. The impact is strongest in the residential, commercial and chemical products sectors. The effect is to eliminate the B.C. Hydro firm surplus in 1989, approximately one year earlier than in the base case (figure 7.2).

Figure 7.3 : Low Economic Growth Case Primary Energy Requirements



7.3 Low Economic Growth

The major stock market correction of October, 1987 caused many economic forecasts to be revised downwards, with some predicting a recession in 1988. To show the impact on energy requirements of reduced economic growth, a forecast was prepared based on the Ministry of Finance and Corporate Relations July, 1987 low growth scenario. In this forecast, provincial GDP increases at 0.9 percent per year, compared with 2.8 percent in the base forecast.

The effect of lower growth is to reduce the growth rate in total provincial energy requirements from 1.8 percent to 0.6 percent per year. Figure 7.3 shows the impact on total primary requirements.

An economic slowdown will have its greatest impact on the Province's resource based industries and consequently on the requirements for natural gas and electricity. In this low growth scenario, natural gas and electricity are respectively lower by 9.4 percent and 8.0 percent than in the base case.

Appendix A

Table A.1

Energy Conversion Factors

Fuel Type	Conversion Factors
Coal	1 kilotonne = 29.30 terajoules (TJ)
Petroleum Coke	1 megalitre = 42.38 TJ
Natural Gas	1 gigalitre = 38.35 TJ
Crude Oil	1 megalitre = 38.51 TJ
Motor Gasoline	1 megalitre = 34.66 TJ
Diesel Fuel Oil	1 megalitre = 38.68 TJ
Light Fuel Oil	1 megalitre = 38.68 TJ
Heavy Fuel Oil	1 megalitre = 41.73 TJ
Aviation Gasoline	1 megalitre = 33.52 TJ
Aviation Turbo Fuel	1 megalitre = 35.93 TJ
Still Gas	1 megalitre = 41.73 TJ
Propane	1 megalitre = 25.53 TJ
Butane	1 megalitre = 28.62 TJ
Ethane	1 megalitre = 18.36 TJ
Hog Fuel	1 megalitre SWE* = 7.69-9.10 TJ
Electricity	1 gigawatt hour = 3.60 TJ
	(*SWE = Solid Wood Equivalent)
kilo = 10^3	1 megalitre = 1000 cubic metres
mega = 10^6	1 Btu = 1054.615 joules
giga = 10^9	1 cubic foot of gas = 1030 Btu
tera = 10^{12}	1 barrel = 0.15891 cubic metres
peta = 10^{15}	1 cubic foot = 0.02832784 cubic metres
exa = 10^{18}	

APPENDIX B

TABLE B.1
SUMMARY OF PRIMARY AND SECONDARY ENERGY
(PETAJOULES)

TOTAL ENERGY

	1986	1987	1988	1989	1990	1991	1992
Residential	122	118	129	131	134	135	136
+Commercial	81	80	86	88	91	94	96
+Industrial	399	412	426	437	447	449	456
+Transport	205	213	205	205	206	207	206
+Non-energy	23	25	24	24	24	24	24
+Pipeline, Transmission Line	24	25	25	26	26	27	28
=Secondary Demand	854	873	895	912	928	936	946
+Fossil Fuels Converted To Elec.	13	13	14	15	21	24	27
+Used In Energy Supply Industries	23	25	25	24	25	25	24
-Elec. Generated By Fossil Fuels	7	7	7	8	11	12	13
=Primary Demand	883	904	926	944	963	972	984

NATURAL GAS

	1986	1987	1988	1989	1990	1991	1992
Residential	65	61	69	71	73	74	74
+Commercial	34	33	37	38	39	40	41
+Industrial	72	78	82	85	88	88	90
+Transport	1	1	1	1	1	1	1
+Pipeline	8	8	9	9	9	9	9
=Secondary Demand	181	180	197	204	210	212	215
+Gas Converted To Electricity	3	4	4	5	7	8	10
=Primary Demand	184	184	201	209	217	220	226

REFINED PETROLEUM PRODUCTS

	1986	1987	1988	1989	1990	1991	1992
Residential	17	16	18	17	17	16	15
+Commercial	12	12	14	14	15	15	15
+Industrial	52	53	54	55	54	54	54
+Transport	204	212	204	204	205	206	204
+Non-energy	23	25	24	24	24	24	24
=Secondary Demand	308	318	314	314	314	315	313
+RPP's Converted To Electricity	4	3	3	3	5	5	6
+Refinery Own Use	20	21	21	20	21	20	20
=Primary Demand	331	342	338	337	339	340	339

TABLE B.1 (CONT.)
SUMMARY OF PRIMARY AND SECONDARY ENERGY
(PETAJOULES)

ELECTRICITY

	1986	1987	1988	1989	1990	1991	1992
Residential	39	40	42	43	44	45	46
+Commercial	35	35	35	37	38	39	40
+Industrial	88	92	94	96	99	100	104
+Transmission & Distribution Use	15	16	17	17	17	18	18
=Secondary Demand	178	185	187	193	198	201	209
-Elec. Generated By Fossil Fuels	7	7	7	8	11	12	13
=Primary Demand	171	178	180	185	187	190	196

COAL, WOOD WASTE AND OTHER FUELS

	1986	1987	1988	1989	1990	1991	1992
Industrial	187	190	196	201	206	207	208
+Transport	0	0	0	0	0	1	1
=Secondary Demand	187	190	197	202	207	208	209
+Converted To Electricity	7	6	7	7	9	10	11
+Coal Mine Own Use	3	4	4	4	4	4	4
=Primary Demand	197	200	207	213	220	222	224